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News

Budget Boosts Overall Research But Cuts NOAA and USGS Funds

Science in general, and physical sciences in particular, show growth far above projected inflation in President Ronald Reagan's fiscal 1984 budget proposal. Total funding requested for all federal research and development. including facilities, is \$47 billion, up 17.2% over fiscal 1983, jumping hurdles over the 5% projected inflation rate. Defense R&D is slated to soar 29% to \$30.3 billion, while nondefense R&D would rise 0.4% to \$16.7 billion. Table 1 shows the proposed research and development budgets by major departments and agencies.

Basic research in fiscal 1984 would be increased 9.9% over the fiscal 1983 level (Table 2). The growth rate of basic research in agencies primarily supporting the physical sciences and engineering sciences is 5 times greater than in those primarily supporting the life sciences.

Of the four nondefense agencies most directly involved in geophysical research, the National Science Foundation (NSF) fared the best with an 18.1% increase; the National Aeronautics and Space Administration (NASA) budger rose 3.9%; and the U.S. Geological Survey (USCS) and the National Oceanic and Atmospheric Administration (NOAA) budgets fell 7% and 10%, respec-

Congress now has the task of reviewing the President's budget request and, if Congress desires, to alter it. Eas will track the budget

process through Congressional approval.

In the following analysis, numbers may not total because of rounding.

NSF Budget Boosted

The fiscal 1984 budget request for NSF is \$1.292 billion, up 18.1% from fiscal 1983. Three major functions compose the NSF budget; research and related activities; scientific and engineering education activities; and special foreign currency appropriations. Rcsearch and related activities, accounting fur more than 95% of the total NSF budget, got a 17.5% increase in the Reagan budget proposal. Science and engineering education got a 30% boost to \$39 million. In the special forelgn currency category, the budget allocates \$2.6 million—roughly \$0.5 million less than the obligations for the current fiscal year; however, \$918,000 of the \$3.12 million that was budgeted in fiscal 1983 will be carried forward for fiscal 1984.

Under the budget proposal, the Directorate for Astronomical, Atmospheric, Earth, and Occan Sciences (AAEO) would receive \$334.9 million, a 21.3% hike over fiscal 1983, Some of this increase, however, can be attributed to the inclusion of the ocean drilling programs in the directorate; the programs were previ-ously under the aegis of the NSF director. Within the directorate, the astronomical sciences division got a 25.9% increase to \$79.3 million; the atmospheric sciences division got a 20.7% boost to \$90.0 million; earth sciences got a 23.5% Increase to \$42.1 million; ocean sciences got a 9.8% increase to \$89.1 million; and the Arctic research program got a 19% increase to \$7.5 million. Funding for ocean drilling programs is scheduled to grow 59.4% to \$26.3 million.

TASLE 1. Conduct of Research and Development by Major Departments and Agencies

	Obligations			Outlays			
Department or Agency	1982 Actual	1983 Estimate	1984 Estimate	1982 Actual	1983 Estimate	1984 Estimate	
Defense-military							
functions	20,576	23,179	29,882	18,201	21,847	26,844	
Energy related activi-							
ties	4,758	4,712	4,713	4,974	5,012	4,911	
Health and Human							
Services	3,935	4,316	4,418	3,978	4,262	4,339	
(National Institutes of							
Health)	(3,432)	(3,771)	(3,842)	(3,438)	(3,737)	(3,808)	
National Aeronautics and Space Adminis-	(0) 102)	(0)////					
tration	5,084	2,508	2,473	3,220	2,386	2,421	
National Science	0,-0-						
Foundation	975	1.060	1,240	1,014	1,002	1,137	
Agriculture	798	850	849	808	839	848	
Transportation	309	393	519	349	378	451	
Interior	381	373	329	392	411	. 348	
Commerce	290	312	227	285	315 -	249	
Environmental Pro-	400	014					
tection Agency	335	241	208	338	295	250	
Nuclear Regulatory	330	471	. 200				
Commission	221	210	200	209	210	. 200	
Veterans Administra-	421	210	200		-		
tion : 'I	140	165	163	. 138	157	158	
Agency for Interna-	140	100	103	100			
tional Development	. 155	1 80	161	179	200	152	
tional Development All other	165	152	418	426	425	438	
Total	388 -	391		34.509	37,735	42,741	
· Utal	448 38	AN NULL	45.796	37.000	31,130	,-	

Table courtesy of Office of Management and Budget, In millions of dollars, Numbers may not

lotal because of rounding. Includes the Departments of Education, Justice, Labor, Housing and Urban Development and Treasury, the Tennessee Valley Authority, the Smithsonian Institution, the Corps of Engineers, and the Federal Emergency Management Agency.

ic chemistry and aeronomy program will receive \$2.73 million (up 29.7%), while atmospheric technology will get \$7.5 l million, an increase of 25.7%. Experimental meteorology is due to receive a 38.5% hike to \$5.1 million.

Earth and Ocean Sciences

Experimental and theoretical geophysics will get the largest increase in AAEO's earth sciences division—up 48.2% to \$3.7 million. Other major increases go to the experimental and theoretical geochemistry program (up 35.8% to \$7.2 million), the petrogenesis and mineral resources program (up 30% to \$5.2 million), and the mantle geochemistry program (up 29.0% to \$4 million). The increases ihroughout the division would permit year-round continental reflection profiling opera-tions, upgrading of instrumentation, and a major research effort on the evolution and structure of continental crust.

Growth in the ocean sciences division will expand support for crustal studies, especially research that relates to the continental crust in the earth science division. The 59.4% increase in ocean drilling programs assumes a

TABLE 2. Conduct of Oasic Research

	Millions of Dollars			Percent Change		
	FY 82	FY 83	FY 8-1	83/82	84/83	84/82
Total Basic Research Agencies Supporting Primarily Life	5439	6025	6619	10.8	9.9	21.7
Sciences	2422	2678	2755	10.6	2.9	13.7
Agencies Supporting Primarily Physical Sciences & Engineering	3017	3347	3864	10,9	15.4	28.1

Source: Office of Management and Oudget and Office of Science and Technology Policy.

Astronomical and Atmospheric Sciences

Major Steps in the Budget Process

"Appropriation actor is not complaint by Book 30, the Congram proc-tampes my appropriation (i.e., quantuming free form).

For additional information, see Eas, February 9, 1982, p. 148. (Figure from The United States Budget in Brief: Fiscal Year

Comulation of President a Budget | Degraning 19 manba before local result

Found Year

Highlights of AAEO's astronumical sciences division budget include \$2.2 million (up 45.7%) for solar system astronomy and \$9.8 million (up 46.5%) for astronomical instrumentation and development. The National Astronomy and Ionospheric Center has been budgeted for \$6.5 million from NSF (an increase of 21%) and \$315,000 from NASA, while the Kitt Peak National and Cerro-Tololo Inter-American observatories would receive \$21.9 million, up 17.5%. The National Radio Astronomy Observatory has been bud-geted for \$20.6 million (an increase of 28.3%); the Sarranicuto Peak Observatory would receive \$2.6 million from NSF (up 23.8%) and \$415,000 from the Department of Defense. The emphasis on astronomy will allow for the implementation of the most Important recommendations of the Astronomy Survey Committee of the National Academy of Sciences (Eas, May 18, 1982, p. 506).
Among the committee's priorities are improved Instrumentation at universities and

national centers, and feasibility and design studies on the Very Long Baseline Array. Within AAEO's atmospheric sciences divi-sion, the Global Atmospheric Research Program (GARP) has been marked for a 5% eut (to \$4.8 million). Other programs budgeted for at least a 20% Increase are atmospheric chemistry, climate dynamics, meteorology, and solar terrestrial research. The biggest increase—41.4%—goes to scientific computing at the National Center for Atmospheric Re-search (NGAR), NCAR is slated to get \$40.6 million, up 23.8%. At NGAR, the atmospher-

continuation of the Deep Sea Drilling Project using the Glomar Challenger. A recently formed ad hoc advisory group on crustal studies, chaired by AGU President-elect Charles Drake, met as Eos went to press to re view crusial research and to examine the long-term needs and priorities for ocean drilling in this light. Their recommendations could alter program proposals that NSF will present to the House Appropriations Committee on February 15. Eos will have more details in a few weeks.

Polar Programs

All but one of NSF's polar programs show growth beyond inflation. Glaciology prorams, within the Arctic research division of AAEO, would get a hefty 77.8% increase to

\$2 million. The Arctic oceanography program, however, would receive only 2.1% more money (to \$1.2 million) than it did in fiscal 1983 if the budget is passed as it stands. The fiscal 1984 budget request for the U.S. Antarctic Program (which is separate from AAEO) is \$102.1 million, an increase of \$18.9 million above the fiscal 1983 plan. Most of the increase goes for two capital investments: \$5.8 million to replace a large vehicle mainte-nance facility destroyed by fire in December 1981 and \$5 million to initiate a service life extension program on the two oldest LC-130 ski-equipped Hercules aircraft. In addition,

Antaretic occanography research will be boosted 14.8% and Antaretic glaciology research will be increased by 14.3%.

Compared to other directorates, AAEO and the U.S. Antarctic Program did reasonably well. The Directorate for Mathematical and Physical Sciences purse totals \$364.3 mll-llon (up 21.5% from fiscal 1983); the Direc-torate for Biological, Behavioral, and Social Sciences is slated to receive \$223.8 million (up 17.5%); and the Directorate for Scientific, Technological, and International Affairs (bet-ter known as STIA) will receive \$36.8 million,

Engineering

The Directorate for Engineering (allocated \$123 million, up 22%) includes the civil and environmental engineering programs, which encompass the activities of some AGU members. Within the civil and environmental engi neering category, geotechnical engineering i slated for a 21.2% increase to \$4 million; structural mechanics will get a 27.8% Increase to \$3.7 million; hydraulics, hydrology, and water resources engineering will receive an 18.9% increase to \$4.4 million; environmental and water quality engineering will get a 17.9% increase to \$3.5 million; and earthquake hazard mitigation will receive s 9.8% increase to \$19 million.

NOAA Funding Drops 10%

A close look at the President's fiscal 1984. budget request for NOAA reveals an overal program level of \$843.2 million; \$799.8 milion of requested funds plus \$43.4 million in transfers. The \$799.8 million request represents an approximate 10% cut in funding— not including inflation—from the fiscal 1983 continuing resolution for NOAA.

Of the \$799.8 million requested, \$784 mil-

NASA Unit Sets Ambitious Course

After two decades of spectacular successes, planetary exploration has fallen upon hard unies. It has been five years since a new spacecraft was launched toward the planets. and NASA has under current development only one planetary mission—Galileo, which will orbit Jupiter and probe its atmosphere in 1988. The intellectual challenge of understanding the planets and their common origin and evolution has not, of course, declined, and a great deal of exciting work is being ac-complished using data (and samples) from pasi mistions. But planetologists fear the de-nise of their discipline within a few years if momentum cannot be restored to NASA's program of planetary exploration.

One response to this crisis was the estab-isliment in 1980 of a high-level scientific advisory committee to chart a course of planetary missions through the end of this century that would recapture the excitement of the 1960's and 1970's at a price consistent with the current constrained NASA budget. The Solar System Exploration Committee (SSEC), a subcommittee of the NASA Advisory Council, was originally chaired by John Naugle, then NASA Ghief Scientist. In 1982 he was succeeded by Noel Hinners, then Director of the National Air and Space Museum and now Director of the NASA Goddard Space Flight Center (and also president of the AGU Planetology Section). For 1983, the chairmanship uf the SSEC passes to David Morrison, Professor of Astronomy at the University of Hawaii and a former NASA Acting Deputy Associate Administrator for Space Science.

As it enters the final year of its charter, the SSEC is pitting the finishing touches on a core program for planetary exploration through the year 2000. Acutely conscious of the fiscal constraints being imposed on space science today, the Committee has limited itself in this core program to missions with high scientific return at morlest costs. In general, the committee will achieve these savings by avoiding the challenge of new technologies, such as those required for a Mars mobile lauder or a comet sample return; it will rely instead on the proven capabilities of flybys, orbiters, and atmospheric probes. The committee will nim for further savings by a close and carefully plantied spacing of missions to realize maximum inhesitance and common operations. Although the written report is not complete, it seems clear that In spite of these constraints an exciting series of missions is being proposed. If the SSEC core program is put into effect, we should see by the year 1990 launches (in addition to Calllco) of a Venus Radar Mapper, a Mars Ceochemical/Glimatology Orbiter, and a rendezvous mission to the short-period Comet HMP. Under development would be additional missions to the moon, Titan, and a number of asteroids. The SSEC claims that these results can be achieved at a total cost (in current dollars) of \$300 million a year, only one third the budgetary levels of either the mld-1960's or the mid-1970's.

The first mission in the SSEC core pro gram is a Venus Radar Mapper (VRM), designed to produce a topographic map with better than 1 km resolution—comparable to the achievements of the first Mars orbiter, which revolutionized our understanding of the geological history of that planet. VRM, one of four initiatives in the proposed fiscal 1984 NASA budget, is a scaled-down version of VOIR (Venus Orbital Imaging Rader), a mission deleted from the NASA budget in FY 82 by the Reagan administration. In a sense, VRM is archetypical of the SSEC missions, making maximum use of spare hardware and inhented designs, and carrying a modest science payload focused on specific, high-prioriscience and exploration

During 1983 the SSEC will release its report on the core program and will go on to consider the more technologically challenging-and more expensive-missions that were excluded from its initial recommendations. Also, this group will be trying to make sure that as many people as possible are hearing its basic message that planetary exploration is not finished, and that numerous exciting missions are within our capability at relatively modest cost. If this message strikes a resonant chord among Washington decision makers, the United States will maintain its lead in clology through the 1990's.

This news item was contributed by David Morrison of the Institute for Astronomy at the University of Hawaii at Manoa.

Budget (cont. from p. 65)

lion would be allocated to the Iream of the NOAA bodget: Operations, Research, and Facilities: coastal zone management, previous ly a separate appropriation item, has been transferred into that category. Separate appropriations for miscellaneous 'fishing funds' account for the temaining \$15.8 million.

The Operations, Research, and Facilities category is divided intu five scrivities (Table 3), three of which ore detalled in the following paragraphs.

Ocean and Coastal Programs

NOAA proposes to eliminate the 5ea Grant subactivity. Within the nonliving marine te-sources subactivity, the polymetallic sulfides program would be terminated and funds for deep seabed mining and ocean thermal energy conversion (OTEC) research would be reduced. The ocean research subactivity budget roposes an additional \$2.5 million is proposed to expand the ocean climate research program. Ocean research programs slated to end are the undersea resentch program, region-specific ocean pollution research, the Great Lakes research program (and with it, the closing of the Great Lakes Environmental Research Laboratory), and the Chesapeake

The budget for the ocean services subactivity requests an increase to cover the cost of producing publications on tides and currents the entire cost of this program will be funded from appropriations and all receipts from the sale of the publications will be deposited to the Treasury Department. Decreases are proposed for the marine boundary program, for the marine corrent data collection program, and for the development of new technology in support of other ocean programs.

Within the coastal zone management subactivity, monies are requested to complete the phase out of the progroun. Decreases would eliminate the states' assistance program and would reduce funding to the estuarine sanc-

Growth in the funding for the mapping, charting, and geodesy subactivity would help purchase additional receivers to use the Delense Department global positioning system. Funds also are requested for equipment to use interferometry techniques that aim to inprove the efficiency of the geodetic reference system operations. The budget reduces technical support to state geodesy programs and eliminates plans for a geodetic survey of

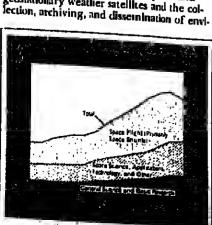
Atmospheric Programs

NOAA's atmospheric programs support weather prediction (including that of the National Weather Service), weather warning services, and associated research. Additional funds are requested to continue the NEX-RAD program. Guts within the public warning and forecasting services would close the southern region lieadquarters; ronsolidate the Alaska and Pacific headquarters; and eliminate regional hydrologist offices. The budget would shrink the fire weather program and terminate the agricultural weather, fruit frost, and aviation area forecast pro-

Increases would go to the atmospheric and hydrological research subactivity for research to improve prediction of severe weather and for investigations into seasonal climate forecasting using improved circulation theories. Decreases would go to weather-related systems development and hydrological research, to state-specific weather modification activities, and to certain Global Atmospherie Research Programs (GARP) grants and projects. Proposed for elimination are all of the research and some of the services at the Solar Environmental Laboratory.

Satellite and Euvironmental Data

Satellite and environmental dats information services is the only activity within NOAA Operations, Research, and Facilities that, as s whole, shows growth beyond inflation in the budget tequest. Most of this growth stems from transfers from NASA of LANDSAT and high-resolution scanner (thematic mapper) uperations. Also covered under this categoty are programs associated with the procurement and operation of the polar and genstationary weather satellites and the col-



(Figure from The United States Budget in Brief: Fiscal Year 1984.)

ronmental data and information.

The programs of the old National Environmental Satellite Service (NESS) and the old Environmental Data and Information Service (EDIS) are funded under this activity. In the satellite services subactivity, the budget allots the geostationary satellite additional funds so that his temperature and moisture sounding capability can be converted from a research prototype to an operational system. Under satellite services, the budget proposes to save money by consolidating satellite field service stations with weather service forecast offices in the same locale. This subactivity, which covers the procurement of satellite spacecraft, their launch, and associated ground systems, would receive additional money to store and check the LANDSAT D' satellite. The budget requests modifications of polar satellites that would allow their positioning in an orbit doser to noon to provide more useful informa-tion to the National Weather Service operational model. A decrease has been requested for a one-satellite polar-orbitng system.

Within the data and information services subactivity, the budget would reduce the di-mate data base effort, eliminate centralized NOAA publication functions, and end direct funding for the NOAA core library system.

Of the 22 vessels that NOAA currendy operates, 10 are proposed for deactivation. Two f these—the Surveyor and the Ferrel—are research vessels; the rest are fisheries vessels. 5ea time is be reduced for other research ves-

NDAA anticipates a 13% reduction in staff in fiscal 1984; although some of this reducdon will be through aurition, some may be through reduction in force (RIF).

USGS Funding Down

U5GS funds will shrink 7% to \$365.5 million under the President's budget proposal. (The fiscal 1983 appropriation enacted to date is \$369.8 million; additions of roughly \$23.4 million in net transfers and requested 'supplementals' are anticipated.) Some of the crease for fiscal 1984 is owed to the transfer of conservation of land and minerals activities to the Minerals Management Service.

Geologic and Mineral Resources

The largest USGS activity, Geologie and Mineral Resource 5 urveys, is budgeted for s 13.7% drop to \$141.9 million. The next large est, Water Resources Investigations, has been allocated \$112.1 million (down \$7.8 million). The National Mapping Program would re-ceive \$77.9 million (down 11.9%) plus \$6 million (up 50%) for digital cartography; although part of the the National Mapping Program, digital cartography activities have een proposed as an appropriation separate from the larger activity

Geologic and Mineral Resource Surveys is divided into five subactivities. Within the mineral resource surveys sobactivity, the budget gives \$9.3 million (an increase of neatly 60%) for the strategic and critical minetals program to enhance researching the mineral potential of the esstern and midcontinent states. Within the geologic hazards subactivity the budget would cut the earthquiske hazard reduction program (down 14.5% to \$29.5 illion), volcanic hazards (down 32.1% to \$7.4 million), ground failure and construc-tion hazards (down 25% to \$2.1 million), and reactor hazards research (down 46.9% to \$1.7

Within the chird subactivity, land resource surveys, the budget halves funds for the climate changes program to \$0.5 million. Although the land resource data application program is being eliminated, USGS says the activities will be conducted throughout the geologic research patt of the agency. Within the energy geologic surveys subactivity, the shale oil investigations program would be cut most deeply: down one third to \$0.6 million. Also scheduled for cuts are coal investigations (down 92.4% to \$9.8 million), utanium/thorium investigations (down 27.3% to \$3.2 million), and geothermal investigations (down 27.4% to \$5.3 million). The fifth subactivity, offshore geologic surveys, would maintain the fiscal 1983 budget of \$13.7 million for the offshore geologic francwork program.

Water Resources

Under the Water Resources Investigations activity, funds for the toxic waste-ground wato \$7.1 million, while acid rain program funding would increase to \$7.1 million, while acid rain program funding would increase to \$9.1 million (up 19.2%). Under the energy hydrology subactivity, funding for coal hydrology would be chopped 71.4% to \$2 million, and funding for oil shale hydrology would deep 76.0% to for oil shale hydrology would drop 76.9% to \$0.3 million. The program for analyses of respin and the program for analyses of regional aquifer systems would drop 8.6% to \$14.0 million, while the environmental affairs program would fall by one fifth to \$0.8 million. The budget eliminates the flood hazard analysis program and, although the data base for the water resources scientific information center will be maintained, the center's funding has been wined out. Programs stromget and ing has been wiped oot. Programs suggested for level funding include national water data exchange, coordination of national water data activities, core program hydrologic research improved instrumentation, water resources assessment, and coal hydrology (within the

TABLE 3. Appropriations for NOAA Operations, Research, and Laplitia

Program	P184 Jt.180	1981 estouate	different
Ocean and coastal programs	148,745	117,125	
Nonliving marine resources	:0:02	1,764	-213
Ocean research	35,434	23,152	-41.9
Ocean services	15,761	13,237	-33.8
5ea Grant	35,000	U	~16.0
Coastal zone management	14.926	6.056	-100.0
Mapping, charting, and geodesy programs	15.289	72,619	-57.4
Marine fishery resource programs	146, 29	92,411	+60.3
Information collection and analyses	75,049	35,732	-36.9
Conservation and management operations	55,500	33,166	-25.7
State and industry programs	15,936	3.226	-39.7
Atmospheric programs	321,263	3093, 197	-70.8
Public warning and Torecasting services	272,221	26 (206)	-3.7
Atmospheric and hydrodogic research	19,012	11,561	-27
Satellite and environmental data and informa-		1 14-911	-9.1
tion services	198,756	212.95a	
Satellite services	66,617	73,279	+7.1
Satellite systems	106,5th1	117,461	+ 10.0
Dats and information services	25,6391	_	+102
Program support	115,813	22,313 95,353	-13.6
Executive direction and administration	54,150		-17.7
Marine services	57,483	11.748	-17.4
Aircraft services	4,180	16,525	- 19.1
Data from NOAA In thousands of July	7,100	1,1080	-2.4

Data from NOAA. In thousands of dollars.
1984 base reflects fiscal 1985 operations, research, and facilities funding levels plus adjusments to base for such items as the proposed 1983 program supplemental, ambipated 1983 proincrease supplemental, and annualization of LANDSA1 operations and reflects transfers such as

those for coastal zone management and the coastal energy impact bond.

subactivity called national water data system:

federal-state cooperative ptogram).

The only initiative within the USGS hudget request for fiscal 1984 falls within the purview of the National Mapping Program. With a \$1 million budget, the new federal mineral land information program aims to provide a computerized data base to answer questions on federal land ownership and mineral oc-

Rounding out the USGS builget are the requested appropriations for facilities (\$13.2 million, which is no change from the current fiscal year) and for general administration (pated \$1.3 million to \$14.2 million). The USGS expects that the number of full-timeequivalent staff members will drop through attrition nearly 5% to 7,587 in fiscal 1984.

NASA Nudges Inflation

Monies requested for NASA in the liscal 1984 budget total \$7.1 billion. This increase of \$267.2 million or 3.9% over fiscal 1983 means that NASA only edges up to the projected 5% inflation rate. (Growth within NASA's programs will be higher, though, heradas programs will be inglier, though, he-cause most of the funds for LANDSAT, pre-viously operated by NASA, now are included in the NOAA budget.) Research and development, which accounts for roughly 80% of NASA's total budget, would increase 3% to \$5.7 billion; the request for construction of facilities would Increase 54.4% to \$150.5 million, while research and program management would climb 4% to \$1.2 hillion.

This is a constrained budget consistent with the serious fiscal and budgetary situation facing the nation, commented NASA Administrator James M. Beggs. 'Nevertheless, it reflects the President's renewed commitment to a strong national space and aeromatiks program as outlined in his two important padicy nents on space and nenonantles list

NASA's tesearch and development links into five categories: space transportation sys-tems, space science and applications, technology utilization, aeronautics and space technology, and tracking and data acquisition. Roughly 60% of the research and development budget would go to space transporta-tion systems, including production and oper-ation of the space shuttle. The allotted funds total nearly \$3.5 billion, a 2.8% decrease from fiscal 1983. The majority of the money was cot from space transportation capability lopment NASA administrators say that there are no plans for a fifth shutde orbiter. However, included in the budget request is hardware development for the Tethered Satellite System, one of four new starts in the get. A cooperative U.S.-Italian project, the new system would permit experiments in space at distances up to 100 km from the shuttle orbiter.

Space Science and Applications

Space science and applications is the second largest of NASA's R&D programs and contains most of NASA programs tied directly to geophysical research. Programs in physics and astronomy would receive \$514.6 million, an increase of 16.7% from fiscal 1985; life sciences would get \$59 million (up 6.9%); solid earth observations would decrease to \$74.4

million (down 43.7%) with the transfer of LANDSAT operations to NOAA; environmental observations would increase to \$163 million (up 3.9%); materials processing in space would lose \$400,000 (1.8%); communications would decrease to \$21.1 million (down 34.9%); and information systems would receive \$8.9 million (up 18.7%). The communications program includes starting of design and development for the Advanced Communications Teclanology Satellite IACTS) project. AUTS, budgeted for \$5 million in fiscal 1981 (plus \$20 million carried forward from liscal 1983), aims to develop and perform in-Hight tests of the high-risk technology needed to ensine continued United States preeminence in the held of satellite communications, according to NASA Admiristrator Beggs. Costs for ACTS will be shared

Programs in planetary exploration, slso within space science and applications, would increase 10.2% to \$205.4 million in the Resgan lindget proposal. The Venus Radat Map-per (VRM) Mission, a new start in this categowould receive \$29 million. VRM replaces the Venus Orbiting Imaging Radar (VOIR) mission that was authorized by Congress is fiscal 1982. Total costs for VRM are expected to be half the estimated custs of VOIR, Development of the Galileo mission would be allocated \$79.5 million, a decrease of 13.2% from the current liscal year and research and anulysis would decline 1.5% to \$45.5 million-Mission operations and data analysis would increase 12.7% to \$43.4 million, while the laternational Solar Polar Allssian would get \$8 udlim, uje from \$6 millon.

Within environmental observations progrums, littles for the shuttle and Spacelab stylical development would hamp 1054% to \$7.0 million and funding for upper atmosphere research satellite experiments an udsshin definition would grow by 42.9% to \$20 million. The largest derteases were proposed to the operational satellite improvement program (down 911% to \$600,000) and to the earth radiation landget experiment (down 35.4% to \$15.5 million).

Aeronautics and Space Technology

Aeronautics research and space technologi (funded at \$438.5 million in fiscal 1984, up 8.8%) would have as its centerplece the Ne merical Aerodynamic Simulation (NAS) capability pruject. NAS, a large computer system, would have 'a major impact on aircraft design methods, improving accuracy and tellability. while at the same time, cutting down on long and expensive wind tunnel and flight (esting) according to Beggs. NAS, one of the four initiatives, is budgeted for \$20 mm in the fiscal 1984 budget.

Of the remaining two categories within NASA research and development, funds for tracking and data acquisition would increase 40.3% to \$700.2 million and technology willi-

zation would drop 55.6% to \$4 million Of the funds allocated for construction of facilities, the largest amounts would go to the Lewis Research Center (\$10.6 million), the Langley Research Center (\$9.5 million), an the Jet Propulsion Laboratory (\$4.3 million). In addidon, the budget allocates \$41.5 million lion to the various space shuttle facilities and \$12 million to various space shuttle payload facilities.—BTR

AGU to Revise Journal Index Terms

AGU is revising its set of indexing terms. If you have auggestions or comments, please contact the appropriate Journals Board member, AGU Journal Editor, or Associate Editor by February 23, 1983, AGU proposes to coordinate its index with a revision of the AIP/APS-PACS index scheme (Phys. Rev. Lett., 48, 11, 1982) (see Rev. Pebruary 8, 1988) 1982) (see Eos, February 8, 1983).

Solitary Waves As **Aviation Hazard**

Scientists at the Australian National Unisersity in Canberra have found that wind shear produced by solitary atmospheric waves is a potentially serious hazard to aircraft operating at low altitudes. In recent years a significant number of aircraft arcidents have been attributed to a sudden, unexpected encounter with low-level wind shear during the landing or takeoff stage. In many cases it has been possible to associate the hazardons shear with one of a variety of well known meteorological wind shear conditions including intense thunderstorm down iliafts, flown-draftproduced density currents, cold frontal systems, and sea breezes. These sources are easily recognized and are usually predictable in the airport environment. In some instances, however, the identity of the wind shear source has been uncertain. Studies of the properties of large amplitude solitary waves in the boundary layer have shown that they produce intense, transient, horizontal and vertical wind shears which are comparable with the well known types of shear, 5olitary wave activity may therefore account for some hitherto unexplained aircraft accidents.

Unul recently, solitary waves were regarded as a corious but relatively unimportant dynamical phenomenon. It is now recognized that these waves are exceptionally stable entities that play an important role in the dynamics of geoplysical fluid systems. Internal soli-

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Cover. Approaching low-level roll cloud

formation produced by a solitary wave propagating in a maritime invetsion toird the southwest over saline coastal flat near Burketown, Queensland, shortly af-ter sonrise on October 1, 1981. Spectacular propagating roll cloud formations of this type are observed with some regularity during September and October along the tropical southern margin of the Gulf of Carpentaria, where they are known as the 'Morning Glory.' The base of the doud is estimated to be about 0.3 km and the top lies at about 1.5 km. The position of the cloud line marks a complex locallzed region of Intense vertical and horizontal wind shear near the surface. The motions of the cloud elements in the strong up-draft along the leading edge and down-draft along the trailing edge combine to give the visual impression that the cloud line is rolling backward as it propagates. Solitary waves are only rarely served as visible, propagating roll clouds. They usually occur as sudden, un-expected, clear-air disturbances which represent a potentially serious wind shear hazard to aircraft (especially jet aircraft, with their relatively slow response) during landing and takeoff. (Photo confrtesy of D. R. Christle)

tary waves, or solitons, occur frequently in the upper layers of the oceans and in inland lakes and fjords. They are also a tlynamical feature in the Martian annosphere.

The first definitive observations of solitary waves in the lower troposphere were made in 1976 at the Warramunga Infrasonic Array lorated near Tennant Greek in the arid interior of Australia's Northern Territory. 'f hese observations have since bren extended through the use of portable microbarometer arrays to determine the coherence and evolution of nonlinear wave ilisturbances as they propagate over the northern Australian region. Perhaps the most important result of this detailed study is the recognition that solinary waves are a commonly occurring, ubiquite component in the dynamics of the lower atmosphere. Nonlinear waves of this type are by no means unique to northern Australia. Large-amplitude solitary waves may be exted to occur wherever conditions of lowlevel stability prevail, and thus they should be regarded as a significant, world wide liazard

Solitary waves in the lower atmosphere take the form of isolated, single-crested waves of elevation which propagate predominandy as clear-air disturbances in a boundary layer inversion waveguide. They are produced quite nationally in the asymptotic decay of any large

amplitude, long-wave disturbance. Under conditions of high lumidity such as those sometimes found in maritime areas they may be accompanied by a low-level, propagating roll cloud formation. The 'Morning Glory' of the Gulf of Carpentaria (see cover) is a spectacular example of a visible manifestatiun of a solitary wave. Cloud formations of this type are relatively rare, however, and are seldon seen in inland regions. It concerns aviation greatly that even in coastal areas these large amplitude waves usually arcur without warning as sudden clear-air disturbances.

Solitary waves in the lower atmosphere of ten exhibit closed circulation in the relative streamline flow pattern. Winds near the surface in these horizontal propagating vortices exreed the speed of propagation and may present a particularly severe hazard to aircraft operating at low ahitudes. The leading up-draft and trailing down-draft in atmoheric solitary waves may exceed 8 m s⁻¹. Maximum horizonial winds occur at the center of the wave near the surface and their speeds typically range from 10 to 15 m s⁻¹ although occasionally they may be much

These transient horizontal and vertical wind shears can affect the performance of aircraft in a variety of ways. Perhaps the most serious simation occurs when an airctaft en-

counters a solitary wave from the front dur ing final approach. In this case the aircraft will first rise above the glide path under the positive influence of increasing head-winds and ap-draft. The normal reaction of a pilot in this situation will be to decrease thrust or increase drag in an attempt to return the aircraft to the standard glide path. This action combined with the sudden loss of lift along the trailing edge of the wave due to decrease ing head-winds and down-draft could leave the aircraft dangerously close to the ground and well short of the runway threshold. Conversely, runway overshoot is produced by solitary waves propagating along the direction

The study of atmospheric solitary waves during the coming year will focus primarily on the specific meteorological factors which lead to their production and long-range propagation. An investigation of the wind shear hazard posed by these waves to aviation in the Australian region has been completed. Detailed findings have been sent to all authorities concerned with air safety and an article on the subject by D. R. Christie and K. J. Muirhead will appear in Aust. Met. Mag., 31,

This news item was contributed by D. R. Christic of the Research School of Earth Sciences, The Austmlian National University, Comberra.

Books

Tectonophysique et Géodynamique: Une Synthèse Géologie Structurale-Géophysique Interne

L. Lliboutry, Masson, Paris, France, 339 p.,

Reviewed by Xavier Le Pichon

Lliboutry is an imaginative physicist with a vast scientific knowledge. On most problems that he discusses, he likes to formulate his own solutions, and he formulates them with frankness and, often, abrupiness. I was, thus, curious to read his new textbook, which is for geological as well as geophysical university

I must say that I was not disappointed. This is an original and interesting book, and I know of nu equivalent. It has an excellent table of contents: carthquakes and structure of the earth; earth magnetic field; remanent magnetization; seafloor spreading; subduction; present plate kinematics; past plate kinematics; nature of crust and mantle; isostasy low velocity zone, and heat flow; vertical motion; elastic and plastic deformations and ruptures; mechanical properties of plates and mantle; nature of lower mantle and differentiation of crust and hot spots; driving mechanisms; tectonic mechanisms; and orogenesis. There is a limited amount of mathematics. Consequently, geologists should not find it too hard reading, although the demonstra-tions may be too concise for most students in geology. On the other hand, the geological ulary is very limited, and each new term is introduced by a short explanation. No previous knowledge of any geology or geophysics is assumed. References are given in an abbre-viated form within the text, and there is a combined subject-author index. The book is well illustrated, mostly with generally well-

chosen figures from major papers.

This is a physicist's book. Lliboutry tries to discuss the physical processes behind the ma-jor geodynamic phenomena and to show that many popular theories have fairly weak bases. This often leads him to propose new ideas or hypotheses, sometimes controversial and based on his own prejudices; for example, he insists on a high 10²⁵ P viscosity lower mande

against most tecent evidence. In detail, I have found many points where I disagree and a few that are simply not corent evidence on the viscosity of the lower mande is biased and does not do justice to the work of Peltier and his collaborators (p. 242). There is no Figure 5-13 (p. 52). He considers guyots and seamounts as synor (p. 57). He states that the quasi-totality of the earth volcanisms occurs along subduction zones which ignores all the mid-oceanic underwater volcanism (p. 249). He states that most of the sediments in 'eugeosynclinal' se-ties are of deep oceanic basin origin and have been piled up in the subduction zone by accretion, ignoring the importance of locally derived arc sediments (p. 307). He proposes for the Messinian Mediterranean evaporitic layer a deep basin origin and compares 'un peo' its formation to the formation of the resent Red Sea hot brines, which is not compatible with recent geologic evidence (p. 323). And, this list is far from exhaustive.

But these are relatively minor points within this well-constructed and highly readable book. To get its flavor, it may be best to quote Lilboutry on geosynclinal terminology which he finds 'confused, useless and danger-ous' or on the notion of orogenic cycle, which period, of the order of 100 M.Y., where two. CFCs but also by an increasing emission level

continents have been colliding, of a thin lithosphere which reaches the plasticity threshold at each orogenic phase.' This is indeed the main conclusion of this book, which integrates in a satisfactory way continental tleformation within a broad plate tectonic framework. Its tesder progressively realizes that the geotlynamic evolution of the surface of the earth is controlled by the mechanical properties of the plates which, unfortidiately are still poorly known, although we do know a great deal more than a few years ago.

Navier Le Pichou is with the Laboratoire de Géodynamique, Université Piecre et Marie Cucie.

Causes and Effects of Stratospheric Ozone Reduction: An Update

Committee on Chemistry and Physics of Ozone Depletion and the Committee on Biological Effects of Increased Solar Ultraviolet Radiation, National Academy Press, Washington, D.C., xi + 339 pp., 1982, \$13.95.

Reviewed by Guy Brasseur

In 1976, the National Academy of Sciences released a report entitled Halocarbous; Effects on Stratospheric Owne. The purpose of this study was to evaluate the likely effect of chlorofluorocarbons (GFG's) on the ozone

layer in the atmosphere.

A number of publications on the same subject have been prepared since then by different official bodies (NASA, World Meteorological Organization, European communities, the British government, etc.). The opinions expressed in these reports were not always in agreement and even sharply differed in cer-

More recently, at the request of the U.S. EPA and In accordance with the Glean Air Act, as amended in 1979, the National Research Council has provided an assessment o the state of knowledge on ozone depletion and its effects on public health and welfare. The report whose purpose is to assess the most recent scientific information has been published by National Academy Press.

The report is divided into two parts. The first part, prepared by the Committee on Chemistry and Physics of ozone depletion chaired by Charles H. Kruger, Jr., reviews the processes determining the ozone concenrine, oxides of nitrogen, and odier species. It describes the current status of stratospheric models and discusses our ability to detect trends in ozone in relation with any anthropogenie action.

In its conclusion, the first part of the report states that 'if the production of CFCs ontinues into the future at the rate existing in 1977, the steady state reduction in total ozone, in the absence of other perturbations, would be between 5 and 9 percent.' These numbers are lower than previous estimates, which shows the necessity of updating frequently our knowledge in stratospheric chem istry. The report also indicates that 'on the whole there have been substantial improvedictions and observed profiles of trace species.' There are a few exceptions, however, and, since the uncertainties can be hardly quantitatively estimated, it is suggested that the discrepancies should be resolved in the future by an orderly application of the scientific method with appropriate interaction between theory and observation.' Finally, the problem of simultaneous perturbations is considered. Ozone may be altered not only by

of nitrons oxide in association with agricultural practices, disposal ul luman and animal wastes, and possible combustion. Moreover, the corresponding ozone reduction might be parily offset by the increased concentration of carbon dioxide or methane. It is therefore recommended 11) to maintain a coordinated research program to understand the spatial and temporal distribution of the key trace species including atmospheric observation, laboratory measurements, and theoretical modeling; (2) to monitor ozone, water vapor. and temperature, using both satellite and ground-base systems; and (3) to assess the consequence for stratospheric ozone of the emission in the atmosphere of all relevant gases such as CFCs, and CFLCl, CH5CCl, N-O. COs, and CHa. Other vehicles such as balloons and aircraft will also contribute to

The text devoted to the chemistry and the physics of ozone depletion is very clear and well written. It is based on six papers provided by six consultants and published as appendixes: (1) Petturbations of the Stratosphere and Ozone Depletion, by R. J. Cicerone; (2) Stratospheric Perturbations—the Role of Dynamics Transport and Climate Changes, by R. E. Dickinson; (3) Recent Developments 5tratospheric Photochemistry, by S. C. Wofsy and J. A. Logan; (4) The Measurement of Trace Reactive Species in the 5tratosphere: A Review of Recent Results, by J. G. Anderson: (5) Trend Analysis of Total Ozone, by H. A. Panofsky; and (6) Detection of Trends in the Vertical Distribution of

Ozone, by A. B. Pittock. The length of the six appendixes is quite disproportional, which reduces the overall coherence of the text. However, these individual contributions are very readable and contain much useful information. The reader particularly interested by these questions should also refer to the report published by WMO and entitled The Stratosphere 1981: The-

ory and Measurements

The second part of the report is devoted to die biological effects of increased solar ultraviolet radiation. It has been drawn by a committee under the chairmanship of R. B. Seilow. Three topics are covered: (1) molecular and cellular studies, (2) ecosystem effects, and (3) human health effects. It is concluded that DNA is probably the primary target in animal cells for most deleterious effects of UV-B and that the major injury to DNA appears to be the formation of pyrimidine dimers which distort the normal DNA helical structure. Both UV-A and UV-B are also detrimental to plant growth, but the adaptability of plan ecles appears to be sufficient to maintain food crop yields. UV-B radiation can also damoge aquatle organisms, but there is no information to predict the magnitude of such adverse effects.

The relationship between increased solar mdiation and the appearance of skin cancers has been widely discussed in recent years since more than 90% of skin cancers other than melanoma seem to be attributable to sunlight. The report states that a 1% increase In UV-B would give a 1-2.5% Increase in basal cell skin cancers and a 2-5% increase in squamous cell skin cancers. The appearance of skin melanoma is partly due to sunlight but probably also to other factors. A predic-tion of enhanced incidence due to increased exposure to UV can therefore not be made. Models of light-induced melanomas are re-quired together with epidemiological studies based on clinical and histological studies.

In summary, the report accomplishes its intended purpose quite well. It should give the policy usakers a good assessment of our present knowledge and of the uncertainties on the causes and effects of ozone depletion.

Guy Brasseur is with the Space Aeronamy Institute in Brussels, Belgium.

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Faculty Position/CSM. The Departments of Geology and Geophysics at Coinrado School of Mines anticipate an opening for o joint appointment at Professor of Geology and Geophysics to commence September 1, 1983.

The successful applicant will be expected to teach courses and conduct research integrating exploration geophysics with petroleium geology. Applicant should possess the Ph. D. degree and responsible experience in exploration research and teaching. A resume and references should be forwarded to Dr. J. J. Finney, Flead; Geology Department or to Dr. George V. Keller, Head; Geophysics Department; Colorado School of Mines; Colorado Gologo Geografia (Colorado Societa). Geologo Geografia (Colorado Societa) (C

Colorado School of Mines is an Affirmadre Ac-tion Equal Opportunity Entployer.

Faculty Posision in Hydrology/College of Forest Resourcea, University of Washington. The College of Forest Resources of the University of Washington in the College of Forest Resources of the University of Washington invites applicants for a tenure track position in the area of forest hydrology. The opening it at the Assistant Professor level and is a 12-month appointment. Gandidates should have a Ph.D. and either academic training or professional experience in forestry. Experienced candidates of exceptional ability and non-U.S. residents will be considered. A strong background in basic sciences locuding quantitative methods in essential. The surcessful candidate and graduate tearhing and to develop a strong interduciplinary research jurgram. The position will be available on or after July 1, 1983. Senti application, currirulum vitae and three letters of recommendation to: Or. Robert L. Edmontis, Chairman, Hydrulogist Search Committee, College of Forest Resources, University of Washington, Seattle, Washington, 18195, 1983. The University of Washington, Seattle, Washington of Washington is an affirmative action equal opportunity employer.

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Teoure Stream Position in Survey Science. The University of Thronto (Erindale Campus) is accepting Applications for a tenure sit cam position in Survey Science at she Assistant Professor kerel, effective puly 1, 1983. A Ph.D. or equivalent is required. The candidate will be expected to teach and conduct research in one or more fields of Survey Science. Expertise is particularly sought in the fields of phonogrammetry, digital mapping and land information system; however, applications submitted by qualified persons in any other speciality in Survey Science, such as geodesy and hydrography, will also be considered. In any case, a strong orientation and interest in computer applications is required. Salary will be in accordance with experience and qualifications.

Applications, including detailed runfculum vitae, publications lists and names of three referees, should be submitted before Alarch I, 1985 to Professor R.G. Gunn, Survey Science, University of Toronto, Erindale Campus, Mississauga, Ontario L5L 1C6, Canada.

Physical Oceanographer/Oregon Stata University. Assistant or Associate Professor, depending on experience. Applicants may be observationalists or theoreticians but must have a Ph.D. in the physical sciences, have demonstrated the ability to coodurt independent high-que flay research and are expected to obtain research funding. Dutles include teaching and supervision of graduate students. Interested candidates should submit a resume and names of three references by 1 March 1983 to G. Ross Heath, Dean, School of Oceanography, Oregon State University, Corvalis, OR 97331.

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Tease. The Department of Geology has a tenuretrack opening beginning July 1983 with starting level of appointment depending on the experience of
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and stable light increases. and stable light isotope mass-spectrometry. Send and stable light isotope mass-spectrometry. Send curriculum vitae, a statement of planned research, and names of at least three references to Dr. A. W. Bally, Chsirman, Department of Geology, Rice University, P.O. Box 1892, Houston, Tesas 77251.

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Assistant Research Oceanographers 10. The (Acan Research Division of Scripps Institution of Oceanography Invites physical oceanographers to apply fur a position as Assistant Research Oceanography Invites physical oceanographers to apply fur a position as Assistant Research Oceanography, the research equivalent of Assistant Professor 1Ph.D. In physical oceanes or equivalent degree required). Candidate must have strong background so applied mathematics and fluid dynamics; stcong interest in ocean dynamics; and proven research and publication record in physical oceanography. This position is funded through ONE contract for two years. Appointment beyond two years is contingent on candidate obtaining eatramural support, it is espected that the majority of research effort during the lwo years will be devoted to the theory and analysis of data on Kuroshio variability. Salary range is \$22,000—\$26,000 commensurate on qualifications. Position start date is approximately 41/83. Please send resource and at least three references to Dr. Russ Davis, Chairman, Ocean Research Division 1082, Chairman, Ocean Research Division 1082, Scripps Institution of Oceanography (E. L. 1082, For additional Information about the position contact Dr. Peter. Niller (619) 452-4100. The University of California, tion Employer.

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Physical Oceanographer/Computer Programmer. The Florida State University is seeking applicants to help carry out alvanced research that intolres aumerical modeling and time series analysis. Candidates should have am M.S. in physical uceanography or computer science and experience with principles of ocean rirculation modeling and oceanography data processing. Experience on GDG mainfrance plus Fortran IV is partirularly desirable. Position svallable to start immediately. Rank is Research Assistant. Saisry will be competitive according to training and experience. Send reaume and professional references by March 28, 1983 to Y. Hsuch, Department of Oceanography, Florida State University. An affirmadre action/equal opportunity employer.

Nuval Postgraduate Behool. The Department of Oceanography invites applications for the position of Adjunct Research Professor in the Ocean Turbulence Laboratory. The successful applicant will be responsible for the organization and execution of oceanic torbulence measurements as well as the interpretation and reporting of the obtained data. The position requires a Ph.D. or equivalent in Physical Oceanography, 3 years of post-doctoral expenience with oceanic measurements and data interpretation, and some familiarily with turbulence instrumentation. The Ocean Turbulence Laboratory is artively engaged in the measurement and interpretation of oceanic turbulence data from a variety of environments obtained with several type of vehicles. The successful candidate will be expected to contribute to the growth and derelopment of the scope of the research performed by the laboratory.

Applicants should send a resume, statement of research record and interests, and the names of at least three references to, Prof. Thomas R. Osbom, Code 680. Naval Postgraduate School, Monterey, Applications will be ronsidered until March 8.

GA 93940.

Applications will be ronsidered until March 8, 1983. Applications should provide a curriculum vitae, three professional references, and a statement of professional (research and instructional) goals. Send letters of application to: Professor Christopher N. K. Mooers, Chairman, Department of Oceanography, Naval Postgraduate School, Monterey, GA 95940. Phone: (408) 648-2552/2555.

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Research Associate/Upper Atmospheric Physics. The National Research Council (Canada) is building a multi-instrument ground based research facility called CANOPUS. One part of CANOPUS is a Data Analysis Network which will provide interactive access to the CANOPUS data by scientists across Canada. A research associate position exists for a person who would be associated with implementing and operating this network. This position will allow some lodependent research on aspects of the CANOPUS data and the holder of the position would be enrouraged to undertake such research. The position requires a Ph.D. in some aspect of upper atmospheric physics (preferably ground based) and extensive computer experience. Any related experience in computer networking, etc. would be an advantage. The initial salary will be in the range from \$24,000 to \$27,000 per year, depending on experience. The appointment will be initially nade for two years and commences as soon as possible.

as possible.

Send resumes and the names of three referees to: Professor J. A. Koehler Institute of Space and Atmosphen'r Studies University of Saskatrhewan Saskatoon, Saskatrhewan S7N 0W0 Canada.

Geophysicisis/Inatitute for Geophysics, University of Texas at Austin. Applications are invited for research scientists with a Ph.D. in the general areas of marine geophysics or theoretical seismology. We mee particularly interested in innovatire individuals who wish to pursue a career primarily in research with some teaching and graduate student responsibilitica. The inatitute is located in Austin and operates riosely with the Description. onutca. The institute is iocated in Austin and operates riosely with the Department of Geological Sciences of the University. It is a vigorous and growing group with interests in both land end marine geophysics. Research facilities include a 167' ahlp equipped with state-of-the-art multichannel ond high resolution seismic reflection and OB8 seismic reflection capabilities.

Applicants should have a demonstrated ability to do creative research. Both midcareer and recent Ph.D.s are encouraged to apply. Applicants should submit resume, the names of at least three references and a statement of research plans and priorities to:

A. E. Maxwell, Director
Institute of Geophysics
University of Texas ut Austin
Austin, TX 78712.
While late applications will be ronsidered, we prefer
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Chemical Oceanographer. Assistant Professor, ienure track position for applicants with recent Ph.D. and competence and interest in contemporary marine chemistry or geochemistry. Duties will include development of research projects and some teaching. Salary negotiable depending upon experience and qualifications. Submit resume and names and addresses of three references by 1 March 1983 for Gregon State University, Corvalits, Oregon 97351. An Affirmatic Action/Equal Opportunity Employer.

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Marine Geophysicist/Teaas A&M University. The Department of Oceanography of Teaas A&M University will have an opening for a tenure track hardly member in Marine Geophysias beginning Separative P83. Preference will be given to randiflates with a strong quantitative background in a wale range of geophysical topics and who have both interest and experience in marine exploration.

The successful applicant will be expected to trank undergraduate and graduate rouses and broughted a vigorous research prugram in his or her sperialty. The position is to be filled at the letter of Assistant Professor. A Ph.D. is required for this position. Salary is negotiable depending upon experience and qualifications.

Applicants should submit a vita along with a letter describing his/ber research and teaching goals and names of five persons for reference to Professon 8. O. Reid, Head, Department of Greeningraphi. Texas A&M University, College Station, TX 77813. The dosing date for applications is March 15, 1903. Tesas A&M University is an affirmative action/equal opportunity employer.

Faculty Position/Department of Geology, University of Illinois at Urbana-Ghampaign. Applications are solicited for a tenure track assistant truthswar position in experimental rock physics. The pusition is expected to be filled by August 1985. Salary is open depending upon experience. We are seeking a creater individual who is interested in either inside or bucille behavior of rocks and their geningiral applications. An earned Ph.D. is required. The Hepartment of Geology, the Materials Research Laboratory and the Engineering College of the University together offer excellent research tacilities for rock physics studies. For equal considerations, interested individuals should send curriculum vitae, list of publications, research interests and the names of three or more references by March 5, 1983 to:

Albert T. Haui

Department of Geology
University of Illinois at Urbana-Champaign
1501 West Green Street
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Postdoctoral Position in Dynamical Meteorology. The Department of Aunospheric Sciences at the University of Washington announces a research pusition for work on problems of large-scale dynamics and transport in the stratosphere and mesosphere. The successful applicant should have demunistrated capability in diagnostic studies of atmospheric circulation and/or in dynamical theory and modeling. Pusition is for one year with possibility of extension in three years and begins about July I, 1983. Camilidates should send curriculture wine and three letters of reference to:

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Department of Annosydeeric Sciences AK-411
University of Washington
Scattle, WA 98105
For information phone 206-543-1052.
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The Pennsylvania State University/Faeuity Posidons. The Department of Geosciences invites applications for three ist tenure track faculty positions, which are expected to remain open intil filled by outstanding geoscientists in any of several fields of specialization. The faculty rank associated with each position is presently open, although salary funds currendy available are sufficient for nt most one senior full professorship. Salaries, which are competitire, will be commensurate with the experiment and qualifications of the appointees. The successful candidotes must be, or late demonstrated the potential to berome, nationally recognized leaders in their fields. They must also have an interest in teaching and advising graduate and undergraduate students. Persons having an interest in collaborate research with other department faculty are preferred. Instructional and research means in which particular needs have been identified inclurie, but are not necessarily limited to: agneous geochemisty, with emphasis on low-temperature rock-witer (groundwater) interartions; heavy isospelurace eleuent geochemistry, with emphasis on global geophysical and gening-ica, with emphasis on global geophysical and gening-ical processes and their geological applications of them; sedimentary geochemitry, with emphasis on quantitatire aspects of carbonate petrology or clay mineralogy; X-ray suseralogy, with emphasis an quantitatire aspects of carbonate petrology or clay mineralogy; X-ray suseralogy, with emphasis an petrological applications of crystallocitentical methods; and modeling of dynamical earth processes using appropriate physical and madiennstical represents.

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The selection of persons to fill these three postdons will be based in part on the extent to which
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and Mineralogy, Geology, and Geophysics. Qualified persons should, therefore, include o brief description of their future research objectives with
their résumes and the names of three references,
and send to:

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The Pennsylvania State University
503-B Delke Building
University Park, PA 16802.
The Peansylvania State University is an affirmative action/equal opportunity employer.

Virginia Polytechnic Institute and State University/Structural Geologiat. The Department of Geologial Sciences invites applications for a tenure-track position in Structural Geology at the Assistant or Associate Professor level. The position involves teaching at the graduate and undergraduate level and supervision of graduate student research, Gandidates should be process-oriented with interests in field related problems. A Ph.D. and strong research is April 15. The position is available from Septem. To apply send o vita with the control of the second of t

ber 1, 1983.

To apply send o vita with list of publications, summary of present and proposed research and the names of three references to: Kenneth A. Erikason, Chairman of Search Committee, Department of Geological Sciences, VPI & SU, Blacksburg, VA

Affirmative Action/Equal Opportunity Employer. Affirmative Action/Equal Opportunity Employer.

Assistant or Associate Professor/CSM. The Geology Department of the Colorado School of Mines interest applications for a faculty position commencing ser of Geology in the specialty of Paleontology and Sedimentary Geology to teach courses at the undergraduate and graduate levels, direct theses and conduct research in these areas. The Pft.D. degree is required. Salary is dependent upon experience.

The deadline for applications is April 15. 1983

L. Finney Head, Geology Department, Colorado School of Mines, Odderf, Colorado School of Mines, Odderf, Colorado Sodol. 1834

John Physics of Colorado Sodol. 1834

June Physics of Mines, Odderf, Colorado Sodol. 1834

June Ph

Atmuspheric Chemistry & Asronamy Division (SCD) Ph.D. Scheicht I or II. The National Lener for Atmospheric Recease Ic the National Lener for Atmospheric Recease Ic in Bonkler. CA Is seeking a country to evaluate and manage the scientific research in Incoherent Scatter Radar data base. We interease with over and radar community to enable to escarch project to insure appropriate scientificate of data base. Foothorp requirements include Ph.D. degrees or reprivatent, research experience in associate, or check to the engineering, atmosphere science, or checks telested field. Familiarity with the incoherent Scatter Radar rechosping for measuring the properties of the immosphere, magnetosphere, and atmosphere. Remonsphere, magnetosphere, and atmosphere. Remonsphere in advanced Fet RELRAN programming, connected madeling data reclination bedingper decell linguistics national scientific recognition and demonstrated leader ship wills la and promoting furderent Scatter Radar research. This is a term position subject to annual reviews and continued furding to project. Send resume PREMPTLY to Esther Black, NCAR, P4C, Box, 3080, Bunbler, CO 80307 at all 303-491-5151 ext. 581 pp information.

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Atmospheric Chemistry & Aeronomy Division (ACAD) and Scientific Campuing Division (SCB) Ph.B. Scientist II or 14. The National Pener for Atmospheric Research in the bullet, CO is seeing a scientist to establish and manage the scientific research in Incoherent Scauer Radar claim base will interact with noer and tadar community to evalidate used to summing the scientific need data hase. Position requirements include Ph.D. degree or equivalent, research experience in aeronomy physics, electronic engineering, atmospheric science, or obsely related field. Familiarity with the Incoherent Scatter Radar techniques for measuring the properties of the iomosphere, magnitophere, and atmosphere. Demonstrated high level of rulin in advanced FCRTRAN programming, numerical modeling data reduction techniques. Level III) requires mational wireful to communing lucobase at Scatter Radar research. This is a term position subject to annual research. This is a term position subject to annual research. This is a term position subject to annual research. This is a term position subject to annual research. This is a term position subject to annual research. This is a term position of a continued funding for propert. Semi-frequence PRCMPTLA to Esther Blazon, NCAR, p. et alloy, 1001. Bonbier, CO 80007 or call 2002-421-5151 ext. 581 to get information. call 2021-121-5154 eye, 584 to get information. NCAR is an equal opportunity/aftermatise acres

Vincent C. Kelley and Leon T. Silver Graduate Fellowships

DEPARTMENT OF GEOLOGY THE UNIVERSITY OF

The Department of Geology of th University of New Maxico Invites ap plications for the Vincent C. Kells and Loon T. Silvor Grodusia Fallow ships. The followships will be awarded on the bosis of the schol asiic rapord and academic promissol groduota opplionnte. Eson fellowship will provide for o generous living et pond of \$1,000/month for 9 to 1 months, ond up to \$2,000/year lo Iravol and roseeroh expenses. The Caswoll Silvor Foundation will pay sil tullion and university tess. The awerde ara made on an ennual basis but may be renewed for up to three years for those individuals in the mestere program, and up to five years for those individuals completing both M.S. and Ph.D. dagree requirements A M.S. thesie may be used as a besis for Ph.D. program, Preference will be given to, but is not restricted to applicanie for the Ph.D. program.

An application for admission to the UNM Gradusta Program, transcripts Graduata Record Exam results (ver bal, math and geology), three letters of reference and a brief etetement of rasearch goals are required for conalderation for the fellowships. Apr. piloation meterials may be obtained

Rodnay C. Ewing Chairman Department of Geology University of New Maxico Albuquarque, New Mexico 87131



Experimental & Solar Physicists

Lockheed Missiles and Space Company's Research Laboratory in Palo Alto, CA, has openings for a SOLAR PHYSICIST and an EXPERIMENTAL OPTICAL AERONOMY PHYSICIST in our Space Sciences Laboratory. These Labs are located on the beautiful San Francisco Peninsula just minutes south of Stanford University.

Solar Physicist

The successful applicant will be expected to conduct and publish original research on solar flares as a member of the Lockheed X-Ray Polychromator (XRP) team. This research WILL make use of existing XRP and related data or new observations to be acquired following the repair of the Solar Maximum Mission (SMM) in 1984. As an active member of the XRP team, this physicist will participate in planning and executing the observing program of the renewed XRP

This position requires a PhD degree or its equivalent plus experience in solar research. A background in plasma physics is highly desirable.

Experimental Physicist

A position in experimental optical aeronomy is currently open where the candidate is expected to carry out experimental/observational programs in auroral and airglow physics using ground based, airborne and spacecraft based optical instruments. This physicist will participate in existing programs, become involved in the development of data reduction techniques for analyzing photometric spectroscopic and imaging data and eventually be expected to develop one's own interests in research programs. A PhD in physics, space physics or a related discipline, the experience in scientific data analysis, the development of space hardware and the involvement in satellite, rocket or shuttle programs is essential. Awillingness to travel to remote sites will be required

Both of these appointments and salary levels will be commensurate with the credentials of the person selected. Oualified and interested candidates should send their resumes, references and list of publications to: LMSC, Professional Employment, Dept. 583-0383, P.O. Box 504, Sunnyvale, CA 94086. Lockheed is an equal opportunity, affirmative action employer, U.S. CITIZENSHIP IS REQUIRED.

Lockheed Missiles & Space Company

Naval Postgraduote School. The Department of Oceanography areaes applications for the position of Adjunt Research Professor in the Orean Turbulence Laboratory. The successful applicant will be responsible for the organization and execution of ocranir turbulence measurements as well as the interpretation and reporting of the obtained rhat. The position requires a Ph.D. or equivalent in Physical Oreanography, 8 years of post-doctoral experience with oceanic measurements and data interpretation, and some familiarity with turbulence instrumentation. The Ocean Turbulence Laboratury is actively engaged in the measurement and interpretation of oceanic turbulence data from a variety of environmenta obtained with several types of vehicles. The successful candidate will be expected to contribute to the growth and development of the scape of the research performed by the laboratory. Applicants should send a resume, statement of research record and interests, and the names of at least three references to Prof. Thoonas R. Osborn, Code 680r, Naval Postgraduate School, Monterey, CA 99940.

Code 680r, Naval Postgraduate School, Monterey, CA 93940,
Applications will be considered until March 15, 1983. Applicants should provide a curriculum vitae, three professional references, and a statement of professional (research and instructional) goals. Send letters of application to: Professor Christopher N.K. Mooers, Chairman, Department of Occanography, Naval Postgraduate School, Monterey, CA 95940. Phone: (408) 646-2552/255S.
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Sedimentologia/Wright State University. The Department of Geological Sciences invites applications for a position in sedimentology, beginning September 1983. The position will be either for a tenure-trark assistant professorship or a one-year visiting position, depending upon qualifications. A clastic ardimentologist is preferred, but strong candicates in any sedimentology field will be considered. The successful candidate will be expected to teach at the endergraduate and graduate levels and to participate to the department's active graduate program. The department is active with 12 faculty with an emphasis on professional practice, yet malnucling a

The department is active graduate program.
The department is active with 12 faculty with an emphasts on professional practice, yet maintening a firm commitment to basic research.

Send o letter of application, curriculum vitae and names of three references to:

Chairman, Search Gonmuttee

Department of Geological Sciences

Wright State University

Dayton,OH 45455

Wright State University is an affirmative-action/equal opportunity employer. Closing date for the position is 15 June 1985.

Faculty Positions/Drexel University. The Department of Physica and Atmospheric Science has several openings for both visiting and tenure track faculty al all levels starting in the fail of 1985. Applicants must have strong teaching and greatest interests in must have strong teaching and research interests in one or more of three areas in the Department: Atmospheric Science—metometeorology, satellite meteorology, and remote sensing of the atmo-sphere.

EXPERIMENTAL PHYSICS—biophysics, quantum optics, nuclear and solid state physics;
THEORETICAL PHYSICS—atomic, molecular and ynamics, quantum optics and non-linear. Interested persons should send resumes and the names, addresses, and telephone numbers of three

names, addresses, and telephone manner for references to:

Dr. Herman Newstein, Acting Head
Department of Physics and Atmospheric Science
Drexel University
Philadelphia, PA 19104
(215) 893-2707,
Drexel University is an equal opportunity and affiliation employer.

Tenure-Track Faculty Position Chemical Oceanography/Marine Geochemistry. We have an opating for an Assistant or Associate Professor of Marine Chemistry, Chemical Oreanography, or Marine Geurhenistry for September 1983. Candidates thould hold a Ph.D. in an appropriate field and have their major research interests in coastal marine environments. By I March 1983 send a complete resume and have at least three letters of reference sent directly to: Dr. D.G. Capone, Gheir, Chemistry Search Gommittee, Marine Sciences Research Center, SUNY Stony Brook, Stony Brook, NY 11794. SUNY Stony Brook is an equal opportunity/affirmative artion employer. AK# 523.

Isotope Geologist/University of Wyoming. The Department of Geology/Geophysics invites applications for a tenure track position at the assistant professor lerel in isotope geology. The applicant's field of specialty may be stable or radiogenic isotopes. The successful candidate will be expected to teach undergraduate and graduate courses and condurt bischer own research of the University of Wyoming includes: crustal evolution in the Archean and Proterozoic; the systematics of magma contamination; carbonate diagenesis; fluid-rock interaction; and the tectonic evolution of compressional and extensional orogenic belts. We hope the successful candidate will complement these studies as well as develop a strong, independent program. Applicants should submit a vita, transcripts, a letter describing future research interests, and names of three references to Dr. Robert S. Houston, Head, Dept, of Geology/Geophysics, PO Box S008, University Station, University of Wyoming, Laramie, WY 82071. Closing dote for applications is February 28, 1983.

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(lenure-track or tenured) in Solid Earth Geophysica. Gonsideration will be given to candidates in earth-quake seismology, morine seismology, and other disciplines in Solid Earth Geophysics. Appointees would be expected to develop a vigorous research program at Lamont-Doherty Geological Observatory and to contribute to undergraduate and graduato teaching in Geophysics. Preference will be given to candidates with arrong backgrounds in quantitative methods of analyzing geophysical data. Qualified candidates should submit their curriculum vitae and the names of three referees to Prof. A.B. Watts, Chairman of Solid Earth Geophysics Search Committee, Lamont-Doherty Geological Observatory, Palisades, New York, 10964 by April 15th, 1883. Columbia University is an equal opportunity/affirmative action employer. madve action employer.

Faculty Positions/The University of Iowa. The Department of Physics and Astronomy anticipates one or two openings for tenure-track assistant professors or visiting professors of any rank in August 1989. Preference will be given to experimentalist in any area for the ienure-track positions. Current research interests include astronomy, atomic, condensed matter; elementary particle, laser, nuclear, plasma, and apace physics. The positions invoire undergraduate, and graduate leaching, guidance of pessearch students, and personal recearch. Interested persons should send a réaumé and a statement of research interests, and have three letters of recompersons should send a resume and a statement of recommendation sent to Sarch Committee, Department of Physics and Astronomy, The University of Iowa, Iowa City, 1A 52242:

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Description of the property of

Research/Senior Research Associate in Planetary Research/Senior Research Asacotate in Planetary Geology. A position is open for a planetary geologistigeophysicia at the Luliar and Planetary Laburatory, University of Arizona. The applicant should have a Ph.D. in geology or geophysics and research experience in impart crisiering, including cratering mechanics and the planetary cratering record. A resume and three letters of reference should be sent to: Robert G. Strom, Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721.

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Postdoctoral Research Associate Mineralogy. Applications are invited for research in high-resolution and analytiral transmission electron microscopy of minerals and their analogues. Experiente in crystallography, materials scientes, or electron microscopy is desirable. Send resume (including transcripts), statement of research interests, and names of three references to Dr. P. R. Sitserk, Department of Geology, Arizona State University, Tempe, AZ 85287. ASU is an EO/AA employer.

University of Nehraska-Lineoin/Geology. Seek tenure-mark Assistant Professor of general area of tectonics, geophysics, structure and economic geodogy effective August. Tearling dimes can be arranged to reflect specialty of successful applicant. Teach two courses per semester. Requires Ph.D. and strong commitment to excellence in teaching und research/publication. Minimum salary \$20,000. Apply by Murrh 31 with application letter, vita, transt ripts, and names of three references to Chairman, Department of Geology, University of Nebruska-Lincoln, Lincoln, Nebraska 68588–0340. Affirmative Action/Equal Opportunity Employer.

Upper Ocean Physical Modelier. A postdoctoral position in upper ocean equatorial modelling appointed by NSF is available in the Mesoscale Air-Sea interaction Group at the Florida State University. Minimum saluty is \$21,000/yr. Qualified Ph.D. should send vita and names of 8 references to Professor James J. O'Brien, The Florida State University, Tallahassee, FL 32306, or call (904) 644-4581.

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CSIRO has a broad charter for research into primary and accondary industry areas. The Organization has approximately 7,400 employees—2,900 of whom are research and professional scientists—located in divisions and accide

GENERAL: The CSIRD Marina Laboratories, which includes the Division of Fleheries Research and the Division of Oceanography, is Australia's principal marine research institution. About 200 scientists and support staff are employed in the Marine Laboratories, investigating the physical chemical and biological features, including fisheries, of the oceans around Australia.

Two well-equipped chartered vessels (53m and 43m) are available for research. The Australian Government has agreed to the acquisition by CSIRO of a modern oceanographic ship to replace the 43m vessel.

On-line access to a CYBER-76 computer is available.

DUTIES: Participate in the work of a research group undertaking analytic and/or numerical modeling of the formation, circulation and mixing of water meases in the upper kilometre of the ocean. The work includes analysis of historical data sets, and planning and implementation of

QUALIFICATIONS: Applicants should have a PhD or equivalent qualification in oceanography or a mixted field, preferably with a strong mainematical background. They should demonstrate both a high level of aptitude for independent scientific research and an ability to collaborate with adjenties working in related disciplines.

TENURE: A lixed-term appointment of 3 years with the possibility of a further term of two years. APPLICATIONS: in writing, stating full personal and professional details, the marnes of at least two referees, and quoting reference number A2568 should reach:

> The Chief Division of Oceanography CSIRO **GPO Box 1538** HOBART TAS 7001 AUSTRALIA By March 18, 1983.

SERVICES, SUPPLIES, COURSES, AND ANNOUNCEMENTS

12th Annual One-Week Short Couesa on Hierarchical-Multiobjective Approach in Water Resources Planning and Massagement. 1983 Theme: The Intreased Use of High Technology and Decision Support Systems in Water Resources Planning and Management, Clereland, Ohio May 9-13. 1983. Cootself Y.Y. Helmes, Cester for Large Scale Systems and Policy Anolysis, Case Westero Reserve University, 1216, 388-4492.

STUDENT OPPORTUNITIES

Graduste Research Asalsantahlps in Barthquake and Exploration Selsmology/University of Ransas. The computer acquisition of digital seismograms for a 20 + oration selsmic network covering the southern end of the Central North American Rift System and the development of sechniques for Very High Frequency (500–1000 Hz) reflection seismology provide excellent components for modern provide excellent components for modern and the second components of the second control of the second co mology provide excellent opportunities for graduate atudy at the M.S. or Ph.D. level. For lurther infor-

Judy at the M.S. OF Ph.D. level. For hird nation and/or application, please write: Dr. George H. Rothe, Chairman Geophysics Program Department of Geology University of Kansas Lawrence, Kansas 66045 (913) 864-4974.

Postdoctoral Posttion/Seismology. Postdoctoral support in seismology is tentatively available far up to a 24-month period. Seeking a recent Ph.D. with interest in regional scientic wove/surface ware propagation. Applications abouth be sent to: Dr. Robert G. Hermann, Department of Earth & Almospheric Sciences, St. Louis University, Box 8099, St. Louis, MO 63156, 314-658-3120.

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Howard University. With an historic commitment to the education of disadvantaged Americans and third-world people, Howard University now offers graduate program leading to the M.S. in Geoscience. This new program is made possible by a grant from the fout Oil Company. Current areas of specialization are field geology/geophysics, geochemistry, and meteorology/hydrology. Fight sudens are it resideane, including from women. Some sipenda and assistantships are available. Potential students

should write to Dr. Eric Ghristofferson, Department of Geology and Geography, Howard University, Washington, D.C. 20059. Gradonte Scholaeships in Geophysics/University of

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Gravity and magnetic potential field studies
Physical properties
Paleomagnetism and rock magnetism
Thermal processes
Grustal structure and magnetism
Tectosic modeling
Seismic data processing
Contact: Dr. Kevin P. Furlosg
Dept of Geology/Geophysics
University of Wyoming
PO Box 3006 Univ. Station
Laramic, WY 82071
307/766-4579.
Graduate Fellowships in Gossial and Continents

307/766-4579.

Graduate Fellowships in Cossial and Continontal Shelf Sedimentatios. The Geology Department of Dalhousic University invites applications for graduate fellowships leading to M.Sc. and Ph.D. degrees with specialization in the field of coastal and continental shelf sedimentation. Potential research treas include shoreface and sediment processes, instrumentation for sediment transport studies and construction of coastal facles modes. Opportunities exist to take part in the upcoming Canadian Coastal Sediment Study and to gain selentific cruise experience on research vesuels from Bedford Institute of Oceanography. Awards cover a calendar year stipend and are rained, after fees are deducted, between \$6500-\$8000. For further information or application please write: plication please write:

Dr. R. Boyd Geology Department Dalhousie University Halifax, Nova Scotia CANADA B3H 3JS.

Membership **Applications** Received

Applications for membership have been received from the following individuals. The letter after the name denotes the proposed primary section affiliation; the letter À denutes the Atmuspheric Sciences section, which was lurinerly the Meteorology section.

Regular Member

Carl L. Axness (H), Dalila Benothman (V), Mark Bergiu (O), Richard W. Couch (T), James E. Court (TI, Donald W. Denbo (O). Jacques Dubois (T), Robert A, Edwards (G), David R, Ford (H), Jarues T, Gross (V), Takeshi Hasegawa (S), L. R. Haury (O), Robert Heinmiller (OI, Gary L. Hitrhcock (O), William R. Holman (T), Kevin Housen (P), Rod-

ney G. Huppi (T).
R. W. Johnson (V), Jean-Marc Luck (VI, Glenn W. Lundell (O), Richard A. Luta (O), Michael C. Macaulay (O), Takaaki Maisuda (V), William M. Nally (S), Allen R. Reed (S), Steren B. Simon (V), Bernd R. T. Simoneir (O), Charles H. Sinex (O), Jean-Pierre Soulas (T), Julianu M, Sturla (S), Leangehwan Sun (O), Robert J, Wahl (O), Michael P, Weinreb (M), Robert J. Williamson (HI, Karen Wishner (O), Edwin A. White (O).

David Bates (Tl. Henry D. Black (M), Blair Britinley (O), James Callian (GP), Antony D. Clarke (A), Edward M. Coppola (P), Vladimir Cvetkovic (H), Teresa M. Danovich (O), Sharon Deemer (H), Alan L. Deino (V), Robert E. Epice (SM), Raymuud Galan (SI, David Guldberg (T), Bill Harbert (GP), Greg Hilder-brand (V), Huseyin B. Iz (G), Isaac I, Klm

(V), Pruscyin B. 12 (O), Israec I. Anni (S), Margaret J. Kingston (V), G. Mathias Koudolf (H), Authory A. Longo (V), Craig E. Mauning (T), S. Kimball May (O), John R. Nelson (T), Gregory J. Newman (H), Sylvia Newsom (GP), Duncan J. W. Nortie (HI, Steven P. Oncley (A), Ray G. Peterson (O), Craig J. Pollock (SM), Duane J. Rosa (H),

Ellen L. Fleniye (V), E. Russell Johnston

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Student Member

John R. Scala (M), Thomas D. Seeba (T), Ksye M. Shedlock (S), Jeff Thorson (S), Ar-thur B. Vaughan (V), William K. Witte (T),

Associate Member

(H), Ann L. Tyler (P).

AGU **Congressional Science** Fellowship

The Individual selected will spend year on the staff of a congressional committee or a House or Senale member, advising on a wide range of scientific issues as they pertain to public policy questions.

Prospective applicants should a broad background in science and be articulate, literate, flexible, and able to work well with people from diverse professional backgrounds. Prior experience in public policy is not necessary, although such experience and/or a demonstrable Interest In applying science to the solution of public problems is desirable.

The fellowship carries with it a stipend of up to \$27,000, plus travel alowance.

Interested candidates should submit a letter of intent, a curriculum vitae, and three letters of recommendation to AGU. For further details, write or cell Member Programs Division, Congressional Fellowship Program, American Geophysical Union, 2000 Florida Avenue, N.W., Wash-Ington, D.C. 20009 (telephone: 462-6903 or 800-424-2488 outside the Washington, D.C. area). Deadline (March 31, 1983

<u>Meetings</u>

Announcements

Volcanoes and Climate



Undated print of an explosive eruption and volcanir cloud from Vesuvius, Italy. that probably occured during late medieval or early modern time. Tephra fallout can be seen from the cloud at left, always the Ring of Somma (the remnant of the great Plinian eruption of A.D. 79, which buried Pompeii and Herculanenin (see Eas, December 28, 1982, p. 1345]]. The Bay of Naples appears in the right loreground. See accumpanying announcement of meeting on volcanoes and climate.

All all-day, interdisciplinary Symposium on the Climatic Effect of Volcanic Dust and Aerosols in the Upper Atmosphere will be held at the National Bureau of Standards in Boulder, Colu., March 18,

Approximately 14 nationally prominent speakers representing a broad spectrum of sciences (climatology, meteorology, space physics, terrestrial and armospheric geophysics, volcanology, remote sensing, and glaciology) have been invited; they will discuss how their specialties contribute to the understanding of explusive tukanism's effects on the earth's atmosphere and climate. Volcanie influence on Himstic changes over the last 2010 years will be emphasized; newly acquired knowledge of olcanic dust and nerosal vells since the 1963 cruption of Agung, Bali, will be stressed. Since the advent of satelline and airborne laser radar (lidar) systems, explosive cruptions of considerable magnitude have occurred at Beerenberg Volcano, Jan Mayen Island; Fuego, Guatemala; Salut Augustine, Alaska; Mount St. Heleus, Washington; and El Ghlehon, Mexico. These lidar systems are capable of rapid surveillance of the presence, mayenut, and optical ilensity of volcania aerosals in the upper atmosphere.

The symposium also will review modern ellmade variations and historical criticions that have produced chromologically duted igh-conductivity layers in the Greenhaud and southern hemisphere gluciers. (The high electrical conductivity results from eposition of SO4 particulate acrosuls from the upper atmosphere.) Topics such as tephrochronology, historical writings. explosive emption mechanisms, optical studies of twilight and auroral glaw, and volcanic dust-veil index measurements of volcanic clouds will be discussed in relation to the energy yield of known volcanic

Included as a special feature will be the presentation of new results from the Solar Mesosphere Explorer Satellite, cont by the National Center for Atmospheric Research and the astrogeophysics ilepart-ment at the University of Colorado. Implications for aircraft flights and for agricul-

ture also will be discussed. The symposium, intended for a national audience of scientists, the press, and interested laymen, will follow several days of review of national climatological programs In Boulder, including the annual geophytical monitoring of climate change and a one-day workshop (scheduled for March

17) on polar meterology.

Presentations are by invitation only to provide a succinct, coherent, and well-inegrated program. However, interested scientists, AGU members, the national press, and others may contact cochairmen Raymond D. Walta (telephond: 303-284-3493) or Jules D. Friedman (telephone: 303-284-5676) for information on altend-

ing.
The symposium is aponsored by tha The symposium is aponsored by tha AGU Front Range Branch and is dospon-streed by the Denver-Boulder Chapter of the American Mejeopological Society in addition, the symposium in activity supported by a gift from Ball Brother Actorises Corporation

Canadian Geology, Geophysics, Minerals

The Joint Arantal Meeting of the Geological Associations of Canada, the Mineralgest Association of Canada, and the Canada Graphysical Union will be held in Viceo British Columbia, May 11 13, 1983.

Lieural sessions offered include consider taplic and mineralogy; eronomic group; guirering geologe: geophysics; geochesia known and information; prefuggodisting gereate the defining probage; perolog; per mindage; periodening grobage; perolog; pe terminal grobage; sedimentology; gradgage structural grobage; terminas; and vokano

There symposia will be offered: the R ! W. Douglas Memorial Symposium (2 coppe ison of the Corelillera with other orogan; 13 0 :RUST results; and marine georgens in Canada.

Annual the special sessions proposed as eastern Parific plate tectonic history and pewrit regime; microplates, paleonagness, and paleonnology of western North Assign distinct stricture of the crist; andring vames in gene hermical thermalynamics que ternaty sea levels and constal geodynamics and stable is nopes in the study of sedimenlosted mineralization.

Two short courses also are scheduled (Co. Petrography: Its Punciples, Method, and Applications' and 'Sediment-Hosted Staiberta Lead-Zim Hepasits'). Rounding outh occring are poster sessions, 7 field injude fore the meeting, and Itt light trips after.

Registration forms and oblitional informations and he obtained from Tom Lieuer, Up versity Extension, Conference Office, P.O. Bux 1700, Va torat, B. C. V8W 2V2 pdephone: 604-721-8475).

The chairman of the local organizing conmittee is A. Sutherland Brown.

Geophysical Year

The complete Geophysical Year latap-peared in the Tue ember 21, 1982, Eas. A haddfar meeting title indicates sponso ship or cosponsorship by AGD,

New Listings

Mny 11-13, 1983 Joint Annual Meeting Geological Association of Canada, Mineral ogical Association of Carada, and Carada Geophysical Union, Victoria, A. C. Cont. fact. University Extension, Conference Of lier, P.O. Hox 1700, Victoria, B. C. V8W 2Y2; (dephone: 604-721-8475).

September 3-7, 1984 Quadrennial Ore Symposium, Halkidiki, Greec, Sponsors b ternational Ozone Commission of IAMAR. Commission of the European Community the Academy of Athens, and the World Mer prological Organization, (Christis S. Zenfo. Chairman, Local Organizing Complice. Physics Department, Campus Ilox 149, Us-versity of Thessalonikl, Thessaloniki, Gree-Send copy of Information request to G.D. Walshaw, Secretary, International Ozone Countriesion, Clarendon Laboratory, Union sity of Oxford, Parks Road, Oxford, OXI 3PH, (J.R.)

Changes

sured by AGU.

June 18-22, 1983 Fifth International Conference on Finite Elements in Water ! sources, new cosponsored by AGU. August 29-Sopiember 1, 1985 Oceans Conference and Exposition, now cospon-

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AND MISSIFICATION AND STRUCTURE THE DEEP-SEA

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D. C. Ste [Ravel1 Treatitute of Geophysics, University of Haveli, Secolule, Navel 19522], K. W. Katchates,
M. S. Nanghamil and S. O. Schlanger
is borscory attained here been carried out to determine the tewess of valocity send attanuacion establing in palagic carbonate sediments from DEFF Mice 855 on the Ontong-lave Pietess. Corpressional valocity (Vp)
massurements were carried out under independently-controlled pour pressure and coefficing pressure.
Valocity adjectory for compressional wasse [borisontal valocity and entropy for compressional wasse [borisontal valocity variest value (vp) in pole of pores. Frevious studies have suggested that valocity assistatopy in palagic carbonate sequences is due integrily to preferred vertical orientation of seal orientation of parts of corporate and first pressure scaling and entropy for many implies. Significant cause of the observed unlantropy for easy implies significant and contacts and first pression attendance of the observed unlantropy for easy implies. Significant and entropy is ultramonic mitematics for corporasional [Q, 1] and Shart [Q, 1] wasse in theserved such that the losses are greatest for propational grain contacts or flat horizontal power. For results are discussed in teres of the possible sacketime of designation. (Deep-sea serbonates, pores, valocity, estendation, solentropy.)

J. Osophys. Res., Red, Paper 282008 Ahoy 3 weeks March 9 Abstract Deadline for the 1983 AGU SPRING MEETING May 30-June 3 J. Osophys. Res., Red, Paper 252008

4199 General (Prest Resting)

ALSURDERITS OF FRICTIONAL HEATING 18 GRANITE

D. A. Lockmar (D.S. Geological Survey, Rebio
Fark, California, 940X5) and P. G. Okubo

A Large (150 I 150 X 40 cm) granite empls,
usen diagonally so hely to eleminate a feelt; we
deformed is a bleelal rock press at normal
strass op 10 6.4: VPs. Displacements and local
notes attress were nomitored sions the feelt;
(200 X 40 cm). Temperature translents up to
10 w°C vero recorded following sick-wills events
at dintences of 0.2 to 1.9 cm from the fault emi
vera related to stress, displacements were used for
noniculal arbs heat Reservated on the fault emi
vera related to stress, displacements were used for
noniculal arbs heat Reservated on the fault during
site. Yrictional heading vessiound to me 94 to
stress, implying a stabulo afficiency of 4 to 8
percount. When water was injected delouted
frictional items judgement. The effoliomy of

frictional hasting was not lowered by the presence of water. Heat generated during deformation of a 0.15-cm-thick layer of sinu-lated gauge was also messared for aliding rates from 0.00 to 9.1 m/s. In these gouge experiments, temperature rises were lass then 0.1°C and were proportional to sidding rate.

J. Geophys. Rus., Red, Paper 180025

Planetology

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5775 Pjesma izrubilida EPIKY ION ACOUSTIC WAVES IN COLLISIONLESS AUGORAL

SPICY ION ACOUSTIC WAVES IN COLLISIONLESS AURORAL PLASMA
W. Lethe (Space Sciences Laboratory, University of California, Bethinja, CA 94780) and C. F. Kennel
A theory of guige clearly fisida to 'inverted V' precipilition regions is formulated and compared with recent spaces of nearward and compared with recent spaces of a clearly fisidal propagate stong the magnetic field as perturbed fore-scounic solitions which intensity by sectinging memorates with reflected particles. The solitions have meleomerated and find any propagate stong the magnetic field as perturbed fore-scounic solitions which intensity by sections at lengths of shows 100 or and maximum electric posential and field emplitudes at 1 - 10 V and 1 - 10 mV/m. They propagate as the local low-countric passed (c., - 10 - 100 km/ms 1, Douglar-skilled by the drift speed of operard flowing cold ions. Both medical and compressive studies of the propagating normality, respectively, are possible. Upward propagating normality successful intensity when the upward flow of innespheric ions assessed monthly 10 r, the restrictive conds to incompletely ions assessed monthly 10 r, the restrictive conds to incompletely ions assessed monthly 10 r, the restrictive conds to incompletely ions assessed monthly 10 r, the restrictive conds to incompletely in the superarce of the incompletely solitions are consistent with the recent observations, although finiture satisfies, both theoretical and experimental are required for an unembiguous interpretation. The volcition of lensized low-converted not not military attributed.

5780 Wave propostion
A THEOST OF THE 10 PHISE 15YMMETRY OF THE JOVIAN
PECEMETRIC SADIATION
KOLO Machinoto and Nelsyn L. Goldstein (Gode 687,

J. Dauphys. Res., Blue, Paper 2A1831

J. Geophys. Sec., Slue, Paper 3A003

Rocks

Physical Properties of

GITO Ensiticity, free\urs. and flow
SSISMIC VELOCITY AND ATTENUATION IN SANDSTONE AT
ELEVATED TEMPERATURES AND PRESSURES
1. D. Jones and A. Nur (Rock Physics Project, Reperiment of
Cosphycies, Bianford Univerticy, Stemford, Co-H305)
New museuremeets of selemic relocity and offeriustics
have been made in the kilolierts frequency renge to lemparatures of 180°C, confining and pero pressure to 800 bers
in Serse sandsone. With increasing bemperature, theor
relocity and elisaustian decrease at all pressures is e
fully enturated rock. The data suggest that thermal release
tion is not a significant less mechanism under these condilions. We propose that dissipation is sourcided by a viscous
duid flow meshenism, in which e stemp irrequency peak in
elianustion is shifted from 84% at room temperature to 8
this at 160°C as the pero fluid viscocity is decreased with
increasing temperature. However, the velocity decrease is
too greek to be accounted for by a change of releasion
thuse. A san-dispersive temperature sofissing in sheer
may castrol the velocities. [Selemic attenuation, temporature dependence, viscous Cos).

posit accounts available.

Particles and Fields-

Magnetosphere

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6510 Itrosphores of pissets
ITOMIC CAYGEN EMISSIONS OBSENVED FOOS PIONESE VINUS
R. R. Meter (F. O. Bulburt Center for Space Sessarch,
Navel Sessarch Laboratory, Cade IIEG, Mashington, DC
203751, R. C. Anderson, Jr. Sud A. I. A. Stewart
Atomic caygen features at 1305 and (556 Å derated
by the Orbiting Ultravioles Spactroster (OUVS) on Pionear Vecus era compared to theoretical solution models.
Lirb scans from these arbits of the OI 1504 Å exhapten
vats analyzed using an improved model which recover the
tentrictive assumptions of complete frequency redistributions and inetheral multiple sertering. Data-redel
comparisons indicate the OI 1504 A exhapt or tates
observed are consistent with on 0 dumity 40% of the
BUS model. It is also found that the exhapt on at
1356 8 is conclusion with the are of the CO fourth
positive band at 1337 A and the DI doubler at 1335,
1358 A, If so O density equal to 10% of the BUS
model is used to calculate the OI endesion rates.
Goophys. Res. text., Paper 11,0000

6575 General (The Grust of Venus) PREORETICAL MODELS OF CHEMICAL AND MINERAL COMPOSITION

V.L.Barsukov (Varnadsky Institute of Canabemietry and Analytical Chamistry, user Academy of Saiencea, Mescow, URSR), V. P. Volkov and I. L. Khadakavaky

Physico-abenical modelling of the atmospheria-lithoaphario intarectico on Venua to presected. The thermodynamic sesseement is carried out in terms of Vecera 11 and 12 and Pinner Venue measurements and the dynamic Atmospheria structure. The subcland atmosphere is interpreted to be a sone of negenuilthrium chemical conditions while the neer-surface layer is presumed to be an squilibrium acon due ta catalytic affacts and law wind velonities. The mineral assembleges of the "weathering orust" are osloulated, The pyrita-anhydrite-magnetits Laboratory for Extraterrestrial Physics, Interplanetary Physics Brunch, NSI/Oudderd Spass Flight Center, Orsanbelt, NO 20171)

No propose on explanation of an esymmetry in the occurrence grobability of the lo-dependent Jovian decembrie redistion. We find that this saymetry erises because when to is in the northern part of the torus may interest the owner than a three ways thee owner the necther of the southern innestation of decembrie tadistion to the northern innestation of decembrie tadistion to the northern innestation of the season of the Alfréo ways and the banding of the magnetic field (Alfrén wing) along this trajectory. The ray paths of the decembrie radiation are embedded using a throadtenational ray graphs program in the Jovian temperature of the two codes of the twirm ionosphore and Blobal magnetic field, as well as for several choices of the ratio of the radiated frequency to the Lauth is also discussed in the govient end of the tality on the Jovian declination of the Lauth is also discussed in the contest of this model. Applies, decembrie resident, in, my treating).

J. Geophys. Sec., Slue, reper 140031 sesemblage is suggested on the buffering system resulting in reducing conditions (PO, = 10" atm). The existence of hydration is problematic and is thermodynamically ognosiveble only for the sulfur enrichment of primary rooks (about 2 wt.#). The es rbonata minarals are suggested to be unstable. (Venus, erust, mineral composition,

theoretical models). J. Geophys. Rss., hed, Yeper 28:342

J. Geophys. Rss., hod, Yeper 28:142

53/OK TEMPERATURES OF SIO, AND TREIR GEOPHTEICAL INFLICATIONS

O. A. Lyengme and Y. J. Ahrsha (California Gentlaus of Technology, Mesadoon, California, 21:751 end A. G. Mitchell (Levrance Liverance Pacianal Leberatory, Liverance Liverance Pacianal Leberatory, Liverance Liverance Pacianal Leberatory, Liverance California, 21:051 end A. G. Mitchell (Levrance Liverance Pacianal Leberatory, Liverance Liverance Pacianal Leberatory, Liverance Liverance Pacianal California, 9:100.

The longerature of \$10, lo high pressures shock lettes has hear meshored for empley of single crystal ocquerts and leved quertx. Pressures between 80 and 10 OHs have been stadied esing project; input: and optical pyrometry ischniques at Lavrasme Liverance National Leberatory. Both data sets ledicate the occurrance of a shock-induced phase transfermation at ~10 and ~50 GPs sions the end fused quertx happendum, respectively. The engasted identification of this transfermation is the asizing of the crystalline phase. Some evidence for this transfert to of salting delayed by estestable superbesting of the crystalline phase. Some evidence for this transfert the situation of the salting and interest the situation of stiched to the salting and the salting respective date; it is possible to construct the situative of stiched to make and intent heat of fusion of ~1.73 and ~3. Milling, wespectively. The solid stiched to Rugonist mestered on e-querts is validaceribed by the libers shock visuality presenting the salting transfer in the salting temperature of stiched to make and intent heat of fusion of ~1.73 and ~2. Milling, wespectively. The solid stiched to Rugonist mestered on e-querts is validaceribed by the libers shock visuality presenting to the Rugonist contered no e-quert has hear fit with u.

1. 614 u. + 2.059 bals up to a pressure of ~200 CPs.

The salting temperator of stiched to contain after a contained of the salting point and the acques lacey and still fusion controlled in the lower ments, the curren

J. Geophys. Res., Sed, Mapon 28:550

8660 Melaerit)cs

DO Welque Departs Produce Martian Meteorites

L. E. Sygulet 1817. Secondmility branch, MASA, Johason Space Seater, Koustan, TX 77088]

Geochronological and geochamical characteristics of several actosoffic meteorites such those expected of Meetian rocks. Several authors have suggested that these meteorites sight have originated on Mars, but as actificatory omplanation has been given of her they may have been ejected from the Martins surface. It is suggested that the oblique leaper of large meteoroids may produce ajacta which is astessed with the ricocheting projectile sed socelerated to velocities in access of Martins except velocity. This assessing in access of Martin escape velocity. This assessing is based on escitay experimental stadies of oblique ispects and on the observation of several large Martins orstars with the characteristic "butterfly" ejects pattern produced by low asple impects. Several acceleration, sechasisms may act on the fartian decision that impact suicities the ricocheting projectile about do vaporized and fluid dynamic drag should ect on the antraised dects. The drag equation can be integrated for an idealized raprasspitation of ricochet and exposited for an idealized raprasspitation of ricochet and exposited for an idealized raprasspitation of ricochet and exposited for an idealized raprasspitation of ricochet large decta fragments, on the order of 1-10 percent of the initial projectile radius could be drag eccalerated to velocities in axcess of the Mertian escape velocity. Espates temperated the recommendation of the second that except and second the second that except the ferritan escape velocity. Impacts temperated to the could be drag eccalerated to velocities in axcess of the Mertian escape velocity. Impacts temperated the second the second that except the ferritan escape velocity. Impacts temperated the second temperated to the could be accepted to occur at a sestion rich escape velocity. Impacts temperated to the could be accepted to accepted to accepted the sec

the observe of lunar meteorlies lead our colination could be a simple observational seffect due to the short terrestriel lileties of mateorites. These considerations are preliminary in the sense that several simplifications and assumptions are made. However, they suggest that a Namian origin of the shargottile maleorites (a dynmetesity specific libergottile relation, oblique lepacts)

J. Camphys. Fas., Sed. Paper 28/700

Seismology

6920 SEPLOSION SEISMOLOGY THERE GIMENSIONAL CEVET AND UPPER MANYLE STRUCTURE AT THE NEWADA TEST OFFS* OFFICE SERVICES CAN ASSESSED SERVICES STRUCTURE
AT THE MENADA TEST OFFE
ELEVEN E. TAYOF IMERICAL EDUCATION
AT THE MENADA TEST OFFE
ELEVEN E. TAYOF IMERICAN SECURITY OF COLUMN
INTERCED TO THE SECURITY SECURITY OF COLUMN
THE MENADA TEST OFFE
ELEVEN E. NATIONAL LABORATORY, University of
Colifornia, Livermore, California, 445501
The threa-disenslonal crust and upper mentle
structure at the MVS is durived by combining
telessismic P-wave travel-time residuals with Po
source rime terms. The MTS time Carms and relative
talessismic P-wave travel-time residuals with Po
source rime terms. The MTS time Carms and relative
talessismic P-wave travel-time residuals by treating the
sapiosions as a network of 'receivers' which record
'sbetp' jourced at the surrounding stardoms.
Utilipation of the Parise terms allows for better
crustal resolution than in possible from talessismic
information mions. Average relative telessismic
information mions. Average relative residuals from
seast to west scross the MTS. However, Me time terms
beneath Rainfor Mean are at least 0.5 and 0.3 seconds
least than thous beneath Public Movers of Muons Pist,
respectively, ledicating the presence of high valuality
created material or crustal chinning beneath Muinter
Mass. The time terms show a slight correlation
with the working-point wellett hears so turnished y
uniform and the largest time terms set susprishingly
uniform and the largest time terms set susprishingly
uniform and the largest time terms set susprishingly
uniform and the largest time terms set of the tops
relative the Province of the upper frust.
The Fortice of the upper trust,
Rainford Mass and Vutos Fist Indicating that pert of the
observed lateral variations are caused by shellow
allers of the upper trust,
Rainford Security Millone Cangor and Ticker Mountain,
calders of the upper
centure.

The Post

*Word performed under the auspices of the U.S. Department of Energy by the Leurence Livermore National Laboratory under contract number U-Pu09-ENG-48." J. Gmophys. Res., Red., Paper 201117

6950 Seismis Sourcut PROPERIES OF SEISMIC HAVE SCATTERING ARUUND WATER INJETTION WILL AT FEWTON HILL MOT DRY GOCK GEOTHERMAL SILE NAME TO BE T

0860 Sebunde sources
IRIPLE RESMIC ZONE AND RECIONAL VARIATION OF
BESSMICTY ALONG THE NORTHERN HONBHU ARC
II. Kewkelin and T. Seno (Department of Goophysics,
Stanford University, Stanford, CA 94508] Neaford University, Stanford, CA 94:305]

The regional variation of selamioty stong the carthern thouses er, ispace, is studied using arcoarcia (scal depths and food members). The season of the continuous designation of the continuous depths and comments are considered in the ISC beliefins. For submerine corresponding, the building as issue, which is not submerine corresponding the building as issue, which is not submerine corresponding the building as issue, which is not submerine to the comments of the continuous than 500 vell-food and the submerine to the continuous than 500 vell-food and the submerine that types of the food members of 181 events string P-wave first rection determines the 181 events string P-wave first rection determines of 181 events the same of through types estipached at the place interface take in organization of the comments of the comments

and in other regions, one or the other of the infrait comes is solves.

The seleminity of roused acoderate size earthquakes (ma>4) combined with the focal mechanism type shows a variation slong the arc which is in accord with the variation of the solvity of great or large serthquakes. Mars large serthquakes do and cooper in the deep threat come, call her threat type nor down-dip compression/tamion type area cooper in and beneath the deep threat come, was find a number of threat type cartifuctate. Further, in the latter meas, in some regions, the down-dip compression and tension type avents of the down-dip concerns a triple placed stratum of the deep threat some and form a triple placed stratum of organization (the triple science series). This study confirms the hypothesis of pravious workers [Seam and Pongaman, [Sil) or the outual relation belowes the strong satings coupling of two converging plats at the deep invited coupling of two converging plats at the deep invited consideration of downs stands cone; (e., the pressue or sheepens of satinity within the state beneath the deep network workers the transmit of downs as strong or what complies, respectively. Here, the west complien could be indepropried as often receivants stip or as loss strates believe after the fest

respectively. Here, the week coupling could be interpreted as either selected by or se loss trains being after the fest large event coursed at the dwep thems! cone.

Triple selected toocs are found offshare of kipsel prefeature, where the deep thrust cone has been broken reseatly in 1978 and offshare of Fukushina prefeature. We arpust a future large earthquake at the deep thrust mane of chorse of Fukushima prefeature because this presence of the triple selemin toin suggests etress has been commissing set 40 years have pussed sinus the deep thrust some sea veptured in 1936. J. Geophys. Res., Red, Peper 281859

6950 Salmaic Sources
A THEREISHIC ANALYSIS OF THE SEM SAURSWICK EARTHQUAKE
OF JAMPARY 9, 1948
G. L. Choy (U.S. Geological Survey, Rox 25048, ME 967,
DPC, Benver, CO 80215), J. Boatweight, J. D. Dewey
and S. Sipkin
The nestyple of the New Erupswich serthquake of
Jamuary 9, 1934 has important laplicagines for the
systectice of estanic he merds in mestace North America.
Although moderate in size (m. 5.7), it was wallresprised telesiamically. Source characteristics and
this carthquake here been determined from analysis of
that cart erre sigilally reched by the Olipha's Wightal
Geimograph Petwork. From broadbend displacement and
velocity remonder of y-marks, we have obtained a dynamic
description of the cryture probace as wall as conventional static proporties of the source. The depth of
the hypocenter is estimated to be 9 by from depth
phases. The foust mechanism determined from the
broadbend data corresponds to predominantly thrust
fealting. From the vertation is the wavalorus tho
direction of the ally ta Leferred to be undig on a
past-dispin NHE-arising front plane. The Staby dip
of the agferred fault pluma sugment that the herselyear depty member the meritaing four the transfer of proporties do
sine a normal fault. From an invested of body-have
pulse duystions, the astimited ripputs length is
5.7 km. Averses proporties of the graph process aster
members by a modest topour analysis of long-period ?

and 08 body vavos. The long-pariod moment of this catthquake was 5.7x1034 dyna-cm. The static and dynamic stress draps are 45 and 78 bers, sespectively, similar to those of rany certhquakes with similar moment is regions that as more elemically active. The joint spicencer decomination (JEO) eight in wes used to locate, restive so the sainsbock, the three telessissically recorded sytembocks that occurred through Warch 31, 1982. The relocated hypocentars of the aftershocks are significantly dislasent from each cities and from that of the mainsbock; they provide sidilitical support for the course dimensions inforced from the wavefork analysis.

J. Goophys. Res., Red, Papes 281952

b950 Joiente Gources
FOCAL GEFTIS AND PAILT PLANE COLUTIONS OF EARTHQUARES UNDER THE TIGETAM PLATERO
P. Moiner (Department of Zerth and Pionetery Sciences,
Messechestte institute of Technology, Cambridge, MA
071391, and M.-F. Chen
We toupewe synthetic and recorded P wave forms to
place constraints on the Jocal dopons and fault pione
solutions of 16 trustal estabagases beneath the highoss
perts (*9600 m) of the Tibetan plateou- Fault plane
solutions for ell 16 events show combinations of Jermani
and striks sitp faulting with T sake ortenned approach
materly dest-west. None of these solutions also thrust
faulting. Thus the date cortobacate provious ifferences that the satist state the solution of all the server
extension. Focal depths for all 10 events are loss
then 15 km eed appear to be between 3 and 10 km. This
style of deformation and times depths of faulting ave
similar to those in the Small and Range province of sho
vasterm United States. Two intermediate depth events
below she crust of southern Fibet also show primarily
normal faulting with onser-west T axes. The solution
for one, discussed by Chee et al. (1981), is unamblguoins. The solution for the other, the event of lugget
t, 1973 (21.59°), 39.17°2, 35-10 km, m. = 5-9 is less
certain. Both apparently occurred in the mantle beasath
a thick, anoismit lower crust, and their occurrance
suggests that britslo deformative occurs there in
carthquakes!.
J. Goophys. Pun., Red. Paper 251712

I. Geophys. Pus., Red, Paper 281712

VISCOPLASTIC BIREGE RELAXATION ON DEEP YAULT SECTIONS AS A POSSIBLE SOUPCE OF VERT LONG-PERIOD ELACTIC WAVES M. Consiste, E. Boschi and K. Dragoni (istituto di Geofisice, Universiti di Bologna, Via Irneri

46, 40126 Bologas, Freigi Observations of very long-period elastic waves ate attributed to 'aijani' serthquahes, oweous which are presumed to ottur at depth in a con-brittle regime. The fault at depth is modeled as a this plantic-viscosisatic gouge layor embadded in an elastic modium. The gourse of ellent serthquevee is envisaged on a protonged, slow alippage of the louit faces, which yields o far-flow radiation specitum strongly deplated in the high-frequency components. The results of the model compare favoutably with the dominant inequanties (~ [0" trad/s), most duration to few hours) and smplitude t ~ 10⁻² cm) of a long-partial parturba-tion recorded at Triosco in the years preceding the 1976 Friuti (feely) earthquaks . that silent contribution may ploy is the overall marthquake merhanism (in particulat de precessor thenemenal is discussed. (Silent earth oult gouge whoology, procuracty phacemaunt.

J. Campbys. Res., Red, Paper 380023

6950 Seissic Sources

KINDATIC ANALYSIS OF STRONG HOPION F AND SY VAVES

ROW THE STRELING SEVENT
C.A. Leagaton, Department of Coosciences, 440 belbs

Suilding, The Pennsylvanie State Duiversity.

Oniversity Perk, PA 16602

P and SY velocicy wave forms from the desting
explosion of 5 between 1906 eve ensigned from a
point of view often teken in earthquake source
scudies. The detoracion occurred in the Italian
exit dome, Mississippi. Valocity recordings taken
from mesty borebes extrong motion intrivante show
the occurrence of significant SY mesty (Perst,
1968). Minemetic Source models are sonstructed by
considering constraints afforded by the presbes
cavity, condicion of the surrounding metalic, and
espects of the F and SY wave forms such as have
polarity and duration. Wave forms such as have
polarity and duration. Wave forms such as have
polarity and duration. Wave forms such as have
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polarity and furstion. Wave forms such as have
polarity and furstion. Wave forms such as have
polarity send that it is automated to the years
cavity geometry. Secondary servives within the property of the second of the surrounding metalic size of the face of the

6910 Extractures of the Gruss and Uppes Mantia THE 00010, BRALE-SCALE CONVECTION, AND DEFFERENTIAL TRAVEL TIME ANOMALIES OF SREAS MAYES IN THE CLETRAL INDIAN OCEAN

Nischet Steft (Department of Canbodiesi Sciences, Frown University, Froyidenes, RI 02912), Dosaid M. Forsych
We have seasured 57 differential travet times for the place pairs 58-5, mf8-68, Se52-85, Se52-8, sec52-85, sec52-85, sec62-85, PEN-C serth sodel; and wern cottened for the elevation of the house polote.
The nean 1-3 senideal secondaried with bounce polote is the central ladies seein in 2-2,820.7 a (East). This

to the Control Indian Seain in -2,830.7 o (East). This contracts sich 44.2 (alony) reported for the vesteen Familio by Siykis and Jordan, and is similed to the -4.0 s found for old continguels outlets. After torrecting for known differences between continguated, sad oceanit aroutel structure and for differences to measurement technique, we find that trayed them to the mantic beneath the Control Indian Sanfo are midway in character between those beneath the pro-Cambridon misselfe. tharacter between those become pre-Cast and those becash the wepters Pealfie Oc and those becaush the veptues Paulis Ocean besig. The fastest differential travel clause atter slong a line yearing close to the canthr of the large folian Gene pooldel low. There is a clear increase in stavel time with distance from the center of the goold low, suggesting that the mounts of the goold low, suggesting that the mounts of the goold socsally may also be largely responsible for the difference between the Central Indian and Familia besine.

The Chapas-Lagoddive Ridge mapse to conside with a translation-from the fast, differential travel Class of the Central Indian Besin to elever differential travel [name associated with between points haseast young see floor fear active spreading supthra. There we also warderious within the departal lodian Besin which are as as related to express the conjunct flactures or to the ups of the ene thour these veriftions are periodic which spread opportunity with the trand which would be expected for lines, conventive rolls in the upper matter (goold, convention, travel times).

J. Copphys. Res., Red., Paper 281940

J., Geophys. Rev., Red., Paper 281960

4 3 6

。这一些是一种的一种,这种是一种,这种是一种,这种是一种的一种,这种是一种,这种是一种,这种是一种,这种是一种,这种是一种,这种是一种,这种是一种,这种是一种, 第一种是一种的一种,我们就是一种的一种,我们就是一种的一种,我们就是一种的一种,我们就是一种的一种,我们就是一种的一种,我们就是一种的一种,我们就是一种的一种的